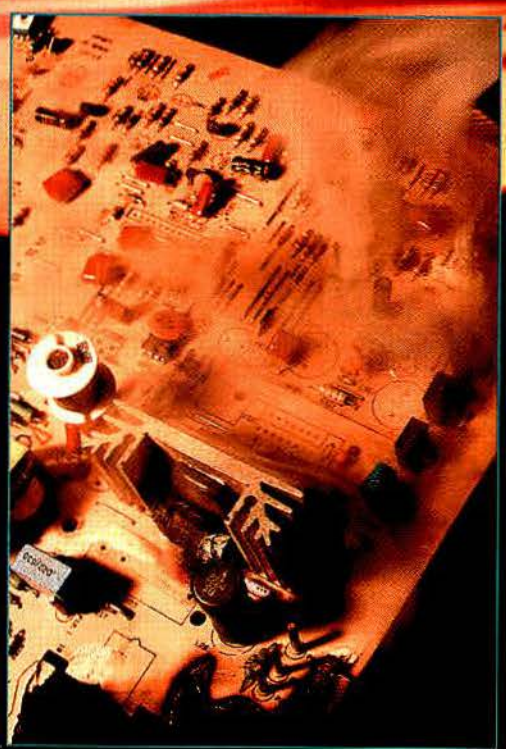
April 1998

Mobile Radio Technology®

Technical information for paging, SMR and private wireless networks.

Zip to Zap: Surge Protection



IWCE Preview and Guide

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SPECIFICATIONS

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Sensitivity: <5mV 30MHz - 900MHz
Maximum Input: +15dBm, 50 milliwatts
Time Between Measurements: 10 milliseconds
Display: 10 digit LCD w/backlight

Timebase: 10MHz setable to +/- 1ppm
RF Signal Strength Bargraph: 16 segments 3dB per segment
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UHF trunking. You know it. You love it.

It's the darling among ex-800/900MHz trunked system operators who sold their systems years ago to the "consolidators." In many instances, UHF trunking provides a re-entry into the two-way radio business for retired SMR operators who have rethought retirement.

On frequencies above 470MHz, where an operator may have exclusive rights to channels in a geographic area, UHF trunking works much the same as trunking on 800/900MHz, with central controllers and no interference from co-channel users. On shared frequencies below 470MHz, the trunking systems must be configured to monitor channels before allowing system users to transmit, so as not to interfere with other co-channel users who are not part of the trunked system. Similarly, these other users who may share the channel are supposed to monitor before they transmit, so as not to interfere with the trunked system.

The trunked system monitors the channels electronically. Its reaction time is measured in milliseconds. If a channel is clear when one of the system users is ready to key a mic or to send a data message, the channel is pressed into use by the trunked system. On the other hand, other, non-trunked users monitor the channel by lifting their microphones from their mic clips, which opens the squelch, and then they listen to hear whether someone is using the channel. If not, they begin transmitting. That's the theory. Of course, there's a certain amount of "walking over" other users who might be heard, yet whose signals sound weak. Sometimes this practice causes harmful interference, and sometimes it doesn't. It's not exactly a case of "no harm, no foul," but maybe it's a case of "no harm, so who cares?"

Several operators of these shared-channel trunked systems have said that they expect to have so many customers on their systems that non-trunked users will be "driven off the channels." The reason is that, once such a trunked system has an abundance of users, it is likely that a trunked transmission will land on a given channel within seconds (or less) of the moment a non-trunked user releases the mic key, whether he is in the middle of a series of transmissions or not. Unfair? Probably. Discourteous? Certainly. A violation of rules? Maybe. Maybe not. The communication is interrupted, but the signals didn't overlap. Is that interference? Who decides?

Clearly, the situation of a UHF-trunked system driving off co-channel, non-trunked users is most likely to be evident in urban areas. That's where many "consolidated" SMR or ESMR systems are withdrawing support for their analog customers or charging higher prices for digital customers (or both), leading dispatch customers to seek analog service elsewhere—commonly, at UHF. Maybe non-trunked UHF two-way radio customers at UHF will be pushed to VHF highband or even lowband if trunking fills their shared channels and they resist conversion.

Ain't that a stitch?

* * *

INTERNATIONAL WIRELESS IWCE 98 COMMUNICATIONS EXPO

It's showtime—IWCE showtime, that is, and we're looking forward to seeing you in Las Vegas April 22–24. Among the *MRT* staff, Mercy Contreras, Dave Keckler, Nikki Chandler, Joyce Bollegar, Dennis Hegg, Dawn Rhoden, Scott Dolash and I will be there; from *RF Design*, Gregg Miller and Roger Lesser. Contributing writers, editors, consultants and advisers to the magazines who will be joining us include Robert Schwaninger Jr., Ernest Worthman, Harold Kinley, Bruce Marcus and Ray Trott.

Nearly 140 people are scheduled to participate as speakers and moderators in the conference sessions, vendor showcases and classes—about twice as many as last year. Many of the arrangements were made by Industry Conference Director Doug Liljegren, with valuable groundwork handled by Ernest, and advice from many, including Robert, and with followup by Jane Van Velson from our trade show division.

Some details about the trade show appear on page 32. Robert offers some comments about IWCE on page 82. In fact, because I read his comments before beginning to write mine, I know I can't top him, so I won't try. I'd copy him, but he'd notice. He's that perceptive.

See you in Vegas!

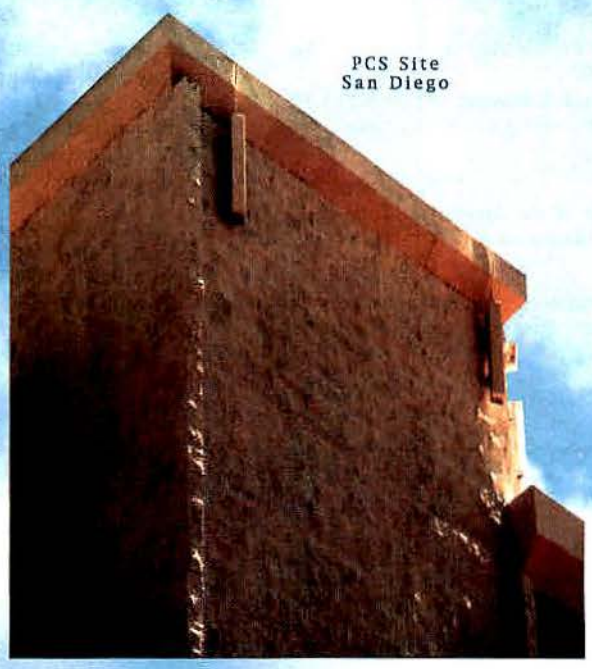
—Don Bishop

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Calendar

April

20–23—Expo Comm/Comdex, sponsored by E.J. Krause & Associates, McCormick Place, Chicago. Contact: 301-493-5500.

22–24—International Wireless Communications Expo, co-sponsored by *Mobile Radio Technology*, Las Vegas Convention Center, Las Vegas. Contact: 800-288-8606.

May

11–14—Telecommunications Resellers Association Spring Conference and Exhibition, San Francisco Marriott, San Francisco. Contact: Susannah Gaylord Stoll, 202-835-9898 ext. 3009.

18–21—Vehicular Technology Conference, sponsored by IEEE Vehicular Technology Society, Westin Hotel, Ottawa, Canada. Contact: 908-562-3870.

20–22—Canadian Wireless, sponsored by the Canadian Wireless Telecommunications Association, Metro Toronto Convention Center, Toronto, Canada. Contact: 613-233-4888, ext. 102.

June

7–11—Supercomm, sponsored by USTA and TIA, Georgia World Congress Center, Atlanta. Contact: 1-800-278-7372.

28–July 2—UTC National Conference & Exhibition, sponsored by UTC, The Telecommunications Association, Hynes Convention Center, Boston. Contact: 202-872-0030.

July

15–17—Communications Expo/Show of the Americas, Miami Beach Convention Center, Miami. Contact: Jackie Gonzales, 305-412-9000.

August

9–13—International Association of Public-Safety Communications Officials (APCO) National Conference, Albuquerque Convention Center, Albuquerque. Contact: 904-322-2500.

September

23–25—Personal Communications Showcase, sponsored by Personal Communications Industry Association, Orange County Convention Center, Orlando, FL. Contact: 703-739-0300.

23–25—PCS Latin America, sponsored by the Personal Communications Industry Association, Orlando, FL. Contact: Cathy Graham, 703-739-0300, ext. 3706.

October

12–14—Wireless Apps, sponsored by the Cellular Telecommunications Industry Association, Bally's Las Vegas, Las Vegas. Contact: 202-785-2842.

14–16—TelecomLatina, co-sponsored by *Mobile Radio Technology*, Miami Beach Convention Center, Miami. Contact: 1-800-288-8606.

19–21—RF Design Conference & Expo, sponsored by *RF Design* magazine, San Jose Convention Center, San Jose, CA. Contact: 1-800-288-8606.

November

11–15—Communications Marketing Conference, sponsored by the Communications Marketing Association, San Diego Princess Resort, San Diego. Contact: Bernie Brownson, 303-371-8182.

12–13—AMTEX, sponsored by the American Mobile Telecommunications Association, Fontainebleau Hilton, Miami. Contact: 202-331-7773.

12–13—Third International Congress on Commercial Trunked Radio, sponsored by the International Mobile Telecommunications Association, Fontainebleau Hilton, Miami. Contact: 202-331-7773.

20—Radio Club of America, Communications Symposium, 89th Anniversary Dinner and Awards Presentation, New York Athletic Club, New York. Contact: Gerri Hopkins, 908-842-5070.

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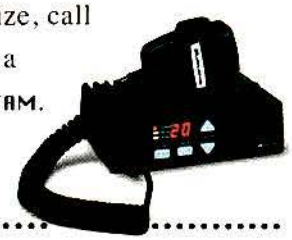
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Tower-top amplifiers—pros and cons

By Harold Kinley, C.E.T.

Over the past few years, advances in technology and engineering have led to the development of high-quality RF amplifiers that are suitable for tower-top use. Today's tower-top amplifiers have much better noise figure, higher third-order intercept point and better immunity to lightning damage. We will look at some of the advantages and disadvantages of using tower-top amplifiers in receiving systems.

Why tower-top?

You may wonder, why go to the trouble of placing an amplifier on top of the tower, with all of its inherent physical disadvantages? The answer lies in the advantage gained in improving the signal-to-noise ratio (S/N) at the receiver input. The S/N at the antenna will be reduced by transmission line loss, so that the SINAD at the receiver input will be less than that at the antenna.

By placing an amplifier near the antenna, the degrading effect of the transmission line loss can be overcome. The noise figure of the *first active device* in a receiving system chain has a dominant effect on the overall system noise figure. If a tower-top amplifier has a very low noise figure, then the receiving system, as a whole, will have a low noise figure.

Site noise considerations

There are situations where the use of a tower-top amplifier might not be as advantageous as one might expect, such as a location where the site noise level is fairly high at the receiver frequency. This is often the situation at *dense* sites, that is, sites where there is a large concentration of transmitters. How can you tell when a tower-top amplifier might offer significant improvement?

Figure 1, below left, shows a test setup that can be used to gauge the level of ambient site noise. The test setup is implemented with a *directional coupler*. This particular directional coupler is for 50Ω systems. The coupling factor (attenuation between input port and coupled port) should be 20dB–30dB or more for this test procedure. The output port is connected to the receiver input. The coupled port is connected to the signal generator output through a 6dB attenuator pad. This ensures a good impedance match to the signal generator.

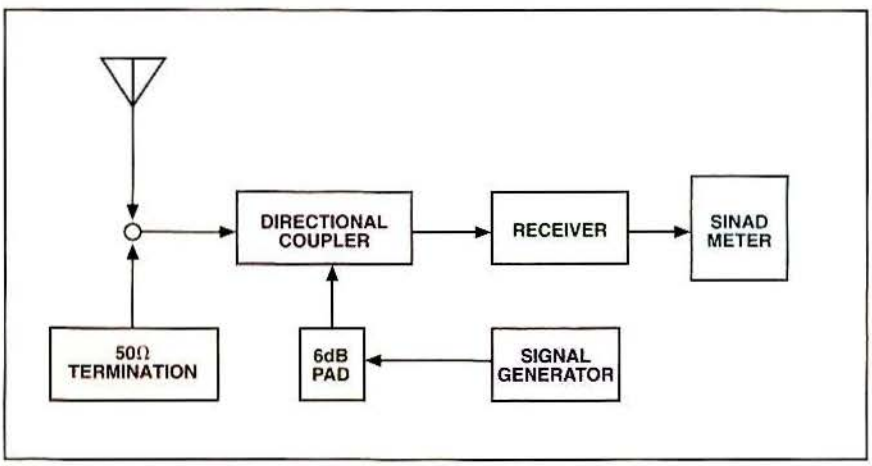


Figure 1. This test setup is used to determine how much the receiver sensitivity is degraded by ambient site noise.

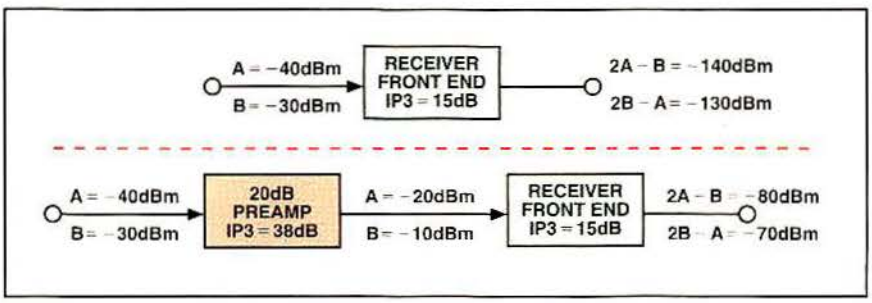


Figure 2. The addition of a preamplifier can increase the level of intermod generated in the front end of a receiver.

Test procedure

With the 50Ω termination connected to the input of the directional coupler, the signal generator is set to the receiver frequency and modulated by a 1kHz tone to a level of ±3kHz deviation. The output level of the signal generator is then adjusted to produce 12dB SINAD at the receiver output. The output level of the signal generator (dBm) is recorded. The antenna is then substituted for the 50Ω termination and the signal generator level is *increased* to again produce 12dB SINAD at the receiver output.

The difference between the current generator level and the previously recorded generator level is indicative of the amount of signal degradation caused by ambient site noise present at the antenna. If the antenna introduces little noise, such that the difference between having the 50Ω termination connected vs. having the antenna connected is very slight, then a high-quality, tower-top amplifier is likely to produce a significant improvement in system sensitivity. If the difference is a few decibels, then the improvement will be less impressive. If the difference is several decibels, then the addition of a tower-top amplifier will probably be a waste of time, effort and money.

Intermodulation factor

It is important that the tower-top amplifier have extremely linear characteristics with high input signal levels. The degree of linearity at high signal levels is indicated by the *third-order-intercept point*. The higher the third-order-intercept point, the better the amplifier will perform in a high signal level environment. The performance of the amplifier (as far as intermodulation is concerned) must be much better than the RF stage of the receiver to which it is connected.

(continued on page 80)

Kinley, a certified electronics technician, is regional communications manager, South Carolina Forestry Commission, Spartanburg, SC. He is a member of the Radio Club of America. He is the author of *Standard Radio Communications Manual: With Instrumentation and Testing Techniques*, which is available for direct purchase. Write to 204 Tanglewylde Drive, Spartanburg, SC 29301. Kinley's email address is *hkinley@aol.com*.

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Communications surge pro

New standards implemented for communications protection in a major public safety network have yielded outstanding results at a reasonable cost. The historical data and a demonstration program may prove the need for adoption of these standards by public and private communications centers.

by Dave Pickett

Power problems or lightning strikes at public safety answering points (PSAPs) are costly not only because of equipment damage but also because of interruption of critical police, fire and ambulance services. Migration to computers by public safety agencies over the past 10 years has been a costly investment. Destruction has occurred because the plant environment is not suited, in many cases, for communications center needs.

There are over 7,000 public safety agencies across America. Most are police and fire departments, many of which are manned by volunteers. What do these centers typically require? They have a radio antenna, a few hundred thousand dollars in computer-aided dispatch (CAD) consoles, a telephone switch and a *lot* of software. Most of this infrastructure gets tied to a copper rod driven in the ground and clamped with a pair of pliers. Usually, four types of telephone circuits feeding the building: 9-1-1, police administration, old seven-digit numbers and data lines for outdial to search databases or to retrieve automatic location information (ALI) for the 9-1-1 caller. Most of this is in a single, 100-pair cable. Most of it is protected with cheap carbon protectors that cost the phone company a buck each. We have proven that is not good enough.

All the old vacuum tube radios are gone; all the black IA2 copper-driven key sets are gone. Mostly, there is an absence of good design and an absence of grounding standards *specific to 9-1-1 facilities.*

Who can use new standards?

Public safety answering points (PSAPs) receiving 9-1-1 calls are of primary interest. The Institute of Electrical and Electronics Engineers (IEEE) has sought standards changes for many years since PSAPs began using low-voltage logic circuits instead of +250V plate currents to do business.

\The National Emergency Number Association (NENA; I joined in 1984, when there were 40 members. There are now more than 5,000 members.) has also written standards for 9-1-1. The results of this work include FCC-adopted regulations, operability standards, training, telecommunications device for the deaf (TDD) and data formats for location information—but "zip" for the protection of equipment.

'When the mass of the ground exceeds the mass of the gear, you will improve your *survival, and equipment survival, significantly.'*

It would be expected that the National Electrical Association, Underwriters Laboratories, the National Fire Protection Association (NFPA) and the Association of Public-Safety Communications Officials—International (APCO) would also have a concerned interest.

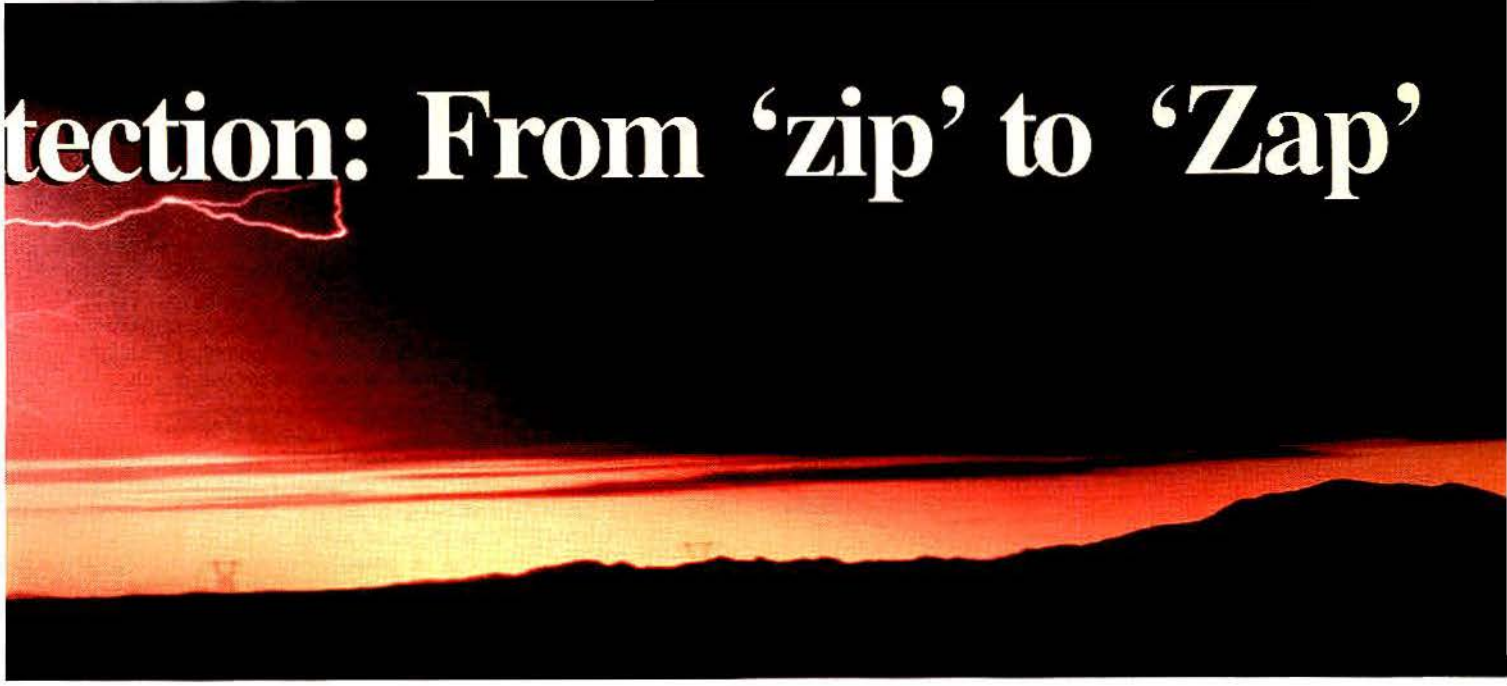
The problem close-up

My own interest started out local, and specific, 13 years ago. The Greater Harris County (TX) 9-1-1 Emergency Network (GHC 9-1-1 ENET) is a communications district created in 1983. The network covers 2,400 square miles, including Harris County, the city of Houston, 36 smaller municipalities and Fort Bend County, which together contain over 152 public safety response entities. The network receives telephony from several dial tone providers that service over four million people in Harris and Fort Bend counties. This 9-1-1 network has been branded the "Ultimate Real-world 9-1-1 Lightning Lab." Thirty-three massive El Niño-related storms have encroached on this network, which is one of the highest frequency lightning strike areas in the United States according to Global Atmospherics of Tucson, AZ.

Lightning strikes in this region of east Texas are above normal both in quantity and volume, because of both geography and geology. Moisture-laden air masses from the Gulf of Mexico collide with warm air masses in the Houston area, 50 miles inland, producing numerous strikes, both cloud-to-ground and ground-to-cloud. Additionally, the region sits atop numerous piezoelectric faults and is strewn with natural salt domes and man-made oil pits for which lightning strikes seem to have an affinity. Meteorological conditions in recent years have seen an increase in the severity of the lightning

Pickett is director of operations for the Greater Harris County 9-1-1 Emergency Network, Houston. Contributions to this article were made by Northern Technologies, Liberty Lake, WA, and Fowler Engineering, Houston.

tection: From 'zip' to 'Zap'



problem. For example, in the area of Missouri City, TX, (a Houston suburb) last November, we recorded 2,215 strikes in one 8-hour period, including 40 or 50 strikes on a single police radio tower. Ground strikes as strong as −159kA have been documented.

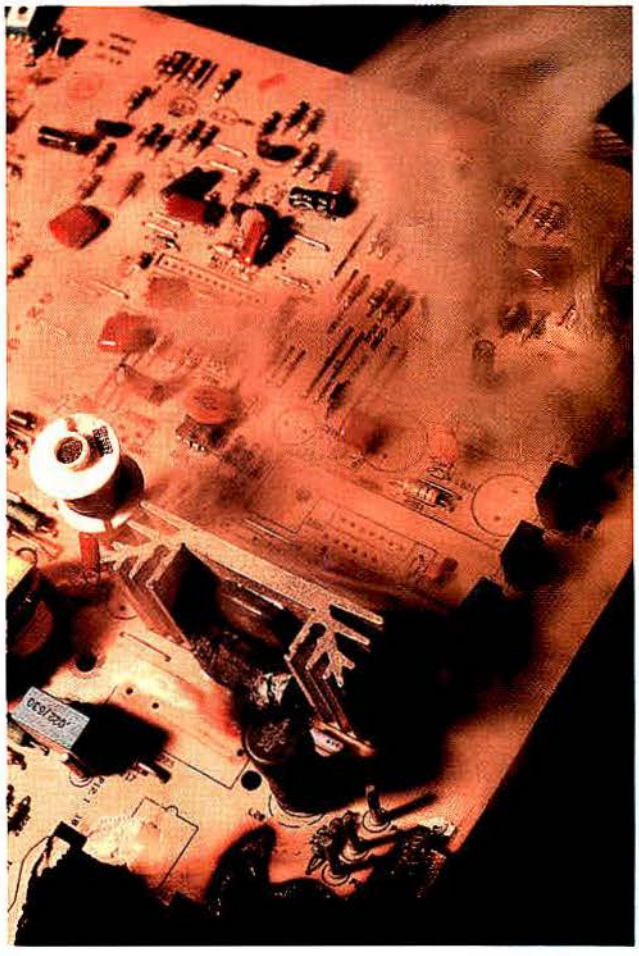
Since 1987, 21 of 39 sites in our network have experienced from one to four strikes, including a massive strike at the Houston police communications center. As a result of my responsibilities for design and repair of the emergency network systems, I set out years ago to find a better way to protect millions of dollars of public safety equipment—all critical, all requiring maximum uptime—from this assault.

Experimenting with protection schemes over time, I developed the following axiom: "When the mass of the ground exceeds the mass of the gear, you will improve *your* survival, and equipment survival, significantly."

Over time, the program steps became:

- ❑ to install silicone avalanche diode line protection on *all* communications and power circuits entering the building, not just the critical ones.
- ❑ to move the antenna away from the building—at least 50 feet, if possible.
- ❑ to bond the main bus and the sub panel to the critical equipment.
- ❑ to use copper coating paste on all lugs.
- ❑ to use clamping at 400 torque pounds.
- ❑ to install center conductor shunt to ground on all coaxial feeds from the tower antenna.
- ❑ to ring the tower with halo grounding.
- ❑ to remove all improperly grounded devices entering the call-taking area.
- ❑ to secure all elevated computer flooring to the common ohm level.
- ❑ to scope all power <5Ω to ground, and 3V peak-to-peak on the neutral ground.
- ❑ to have all installation performed by experienced communications grounding specialists.

These concepts, with a few additional refinements, have been developed over the last 10 years, and comply with NFPA 250.1 and 750.1. They are the keys to banking your equipment protection investment.



Demonstrated success

Our uptime is now at 100%. We have extended the life of all tariffed or owned equipment and achieved better performance from the computers—the noise is gone. (In fact, after we had cleaned up the grounding at one police center, mobile officers thought there was a new radio at the base.) Overall, our callouts have been reduced by 92%. In addition to protecting the equipment, the best result is that it protects our people.

In our experience, a minor change in the method of bonding the main bus panel and the critical 9-1-1 equipment will save millions of dollars of damage caused by lightning strikes. It will also reduce noise on building ground to virtually zero volts. Grounding is not enough. Well-designed, quick response devices for power protection,

line protection and coax protection all play a major role in proper design.

In applying these techniques to our facilities, we have found that a commitment to apply an investment equal to 10% of the capital budget for the equipment that is to be protected is crucial to accomplishing adequate protection. The alternative is someday having to find the budget to replace the full investment. As an example, we received a severe strike at the Pasadena, TX, facility that destroyed about $1 million in radio equipment, owned by the city of Pasadena, that was not yet three months old. Implementing the above procedures cost $60,000—which had an immediate payback one week after we finished, when a 40kA strike hit the same facility, and nothing happened.

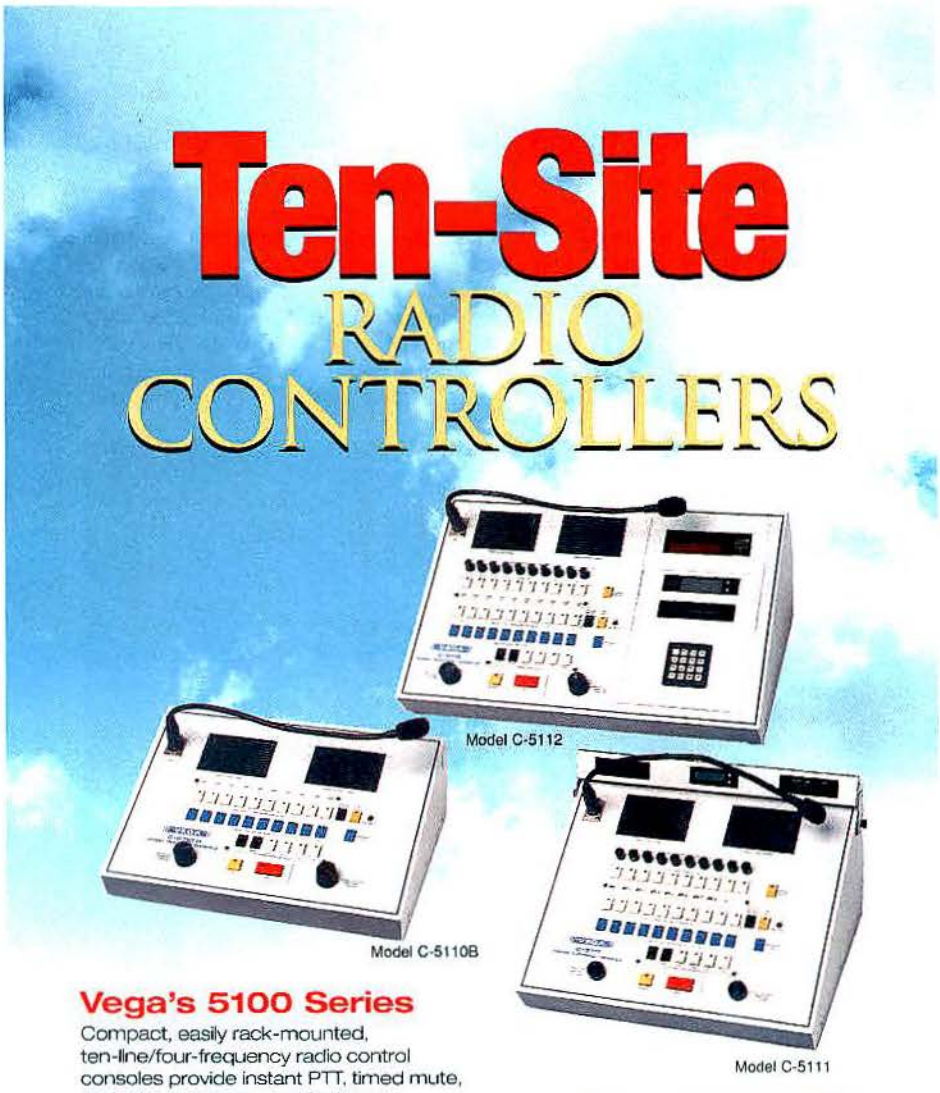
Our team has redesigned grounding methodology with maximum payback, speedy installation and minimum investment. The scheme has been in place in over 80 police, fire and other call-taking centers. The plan has successfully reduced the impact of lightning and power over a ten-year period to near-perfect protection. Noise is eliminated from the power provisioning element of each LAN, virtually eliminating computer rebooting.

Historical data documenting the near elimination of damage in the Greater Harris County 9-1-1 area might be enough to satisfy us locally, but to recommend these procedures as a broader model, more proof needs to be in the pudding; that is, proof by simulation.

If we build it, then we'll know

Ideally, the proof would require building a look-alike police department that could be subjected to man-made simulators, rather than "waiting for lightning to strike" an actual facility. The replica building would be constructed as if for actual use and equipped with the hardware used in police communications, including an antenna, working CRT screens, printers and other devices collected as salvaged but working equipment. This would create actual conditions for rigorous testing to prove the application of these basic bonding techniques. The mock-up site would be protected to the maximum level we could determine, using our methods, then "destroyed," incrementally, with takedowns of protection and grounding, until it equaled a typical site. The testing and results could be recorded on video, as well, for dissemination into the public safety communications community. This visual would be easily understood and would provide public safety and commercial executives an opportunity to understand the need to invest 10% of the original capital budget for protection and grounding.

It was decided that the concepts—which can be used to define minimum grounding and power protection for thousands of public safety facilities through NENA, APCO and national electrical standards—would have more merit and generate more acceptance of the results if conducted at the engineering level and monitored. To accomplish this project, GHC 9-1-1 ENET is cooperating in a joint venture with Fowler Engineering, Houston, which will provide historical data and manpower for testing and recording, and Northern Technologies (NTI), Liberty Lake, WA, which will provide lightning simulation facilities and engineers. GHC 9-1-1 ENET will ship used, but working, devices and technology salvaged from its centers to NTI for the project. The simulation, conceived in 1996, has come



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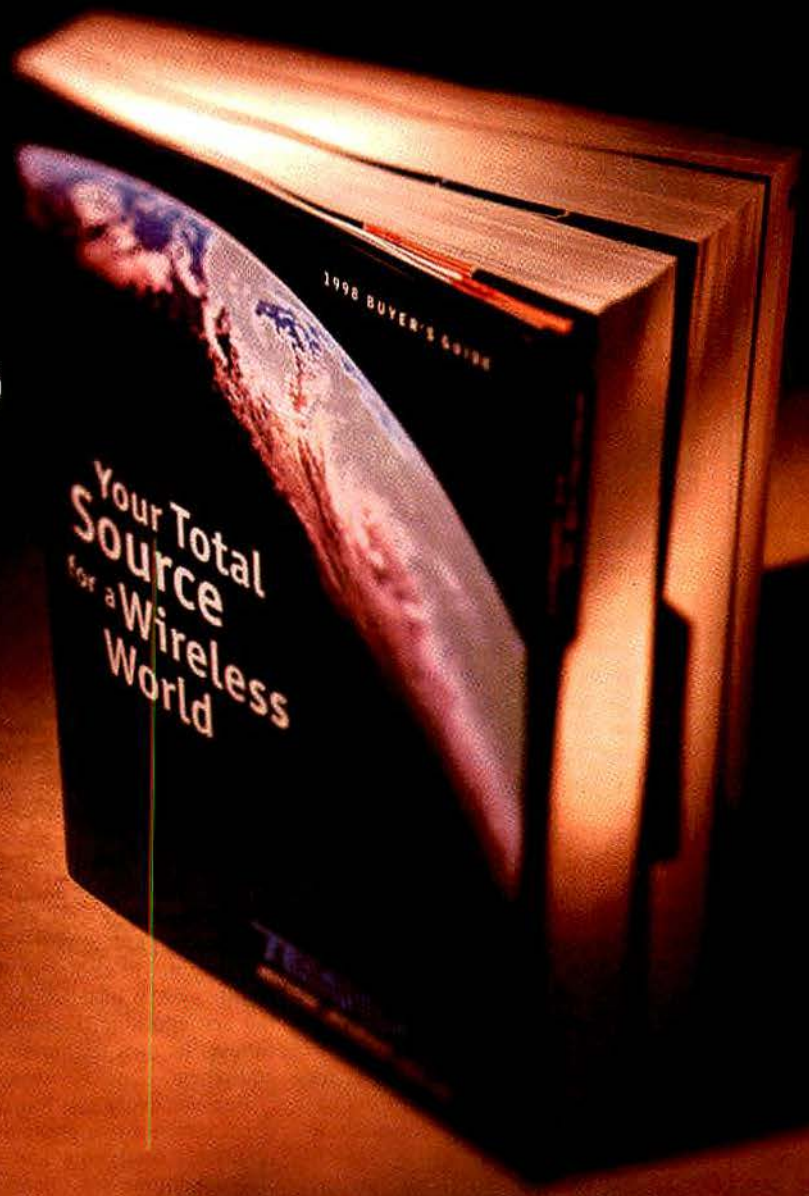
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to be known as "Project Zap."

Project Zap involves the simulation of a police department's electrical infrastructure at NTI's Liberty Lake facility and subjecting it to NTI's "Big Blue" lightning generator, which can produce an 8 × 20 waveform. Now in its final planning stages, the project, expected to begin this summer, will be covered in a future article.

Summary

We have compiled 12 years of historical data, showing near elimination of lightning damage at our facilities in the Greater Harris County 9-1-1 area. We anticipate that monitored testing at NTI will further prove the need to have new protection standards for communications centers, both public and private.

Grounding equipment solves equipment damage problems at cellular site

A lightning strike at a telecommunications tower can fry expensive radio equipment. One New Jersey-based engineering firm dealt with this problem for a New York state cellular provider.

The cellular company's vulnerable equipment included receivers, transmitters and couplers—equipment valued in the millions of dollars. The site included three transmitting antennas and six receiving antennas located on a mountain top in southeastern New York state, near Harriman. Whenever a thunderstorm would occur, it was liable to large lightning strikes.

"It's well known that large towers are very good lightning rods. For example, the towers near Harriman were not only getting hit, but they were sustaining a lot of damage to the equipment inside [the shelters], which is a good indication that there was a grounding problem," said Kevin Leary, P.E., managing director of The Avoca Group, Watchung, NJ. "Basically, it was blowing out circuit boards in computers and radio equipment," said Leary, who is an electrical engineer.

Avoca is an engineering and planning consulting firm primarily involved in consultation, design and planning for the construction of paging, cellular, PCS, satellite, E-911 and cable TV systems. In the site preconstruction phase, Leary said, one of the first things Avoca does is test the site soil resistivity to determine how suitable the soil is for grounding requirements. That information is then given to the construction contractor.

To solve the problems at the Harriman site, Leary first tested the existing grounding system in place: conventional ground rods installed in drilled holes in solid granite. He discovered that the original construction contractor had backfilled the drilled rod holes with material that had washed away over time, leaving the grounding rods rattling loosely in open holes. The ground resistance was high, 50Ω to 60Ω. After assaying the rocky soil, Avoca sent the data to a company that specializes in grounding systems.

"We told them that we had a real problem here since the soil was so rocky. It was not at all the normal type of site that we work with in this part of the country. We usually have at least some kind of soil and ground cover to work with, but this was basically solid granite," Leary said. "Plus, we needed to be able to re-install rods with the least amount of on-site work, because it was such a steep, mountainous area. We had to use a truck-mounted drilling rig that would make it up the twisting, switchback road. We couldn't do any blasting, and it was heavily wooded. So it was a real challenging job."



Leary

"Lyncole, the company we use for grounding systems, was able to evaluate a very difficult site situation and find an economical, efficient solution," Leary said.

Lyncole Industries, Torrance, CA, has been developing and supplying precision grounding systems since 1968. Its leading product is the XIT grounding system. The company also performs on-site system installation, ground testing and educational seminars, and distributes its own testing and monitoring equipment.

Because every site has different soil conditions, no two grounding grids are identical. Analyzing and interpreting soil conditions are important steps in designing a precision grounding system. Extremes in soil moisture, ambient temperature and soil content need different grounding specifications.

An effective grounding system should be more than just a copper pipe attached to a strand of wire. For example, Lyncole starts with a high-quality, 2"-diameter, copper tube with an exothermically welded pigtail. Breather holes are drilled at the top to bring in moisture, and weep holes are placed along the length of the tube in order to form electrolytic roots. The tube is filled with Calsolyte, an electrolytic compound that attracts moisture from the air. The rod is then inserted into the earth and surrounded by a backfill of bentonite clay material Lyncole supplies under the trade name Lynconite.

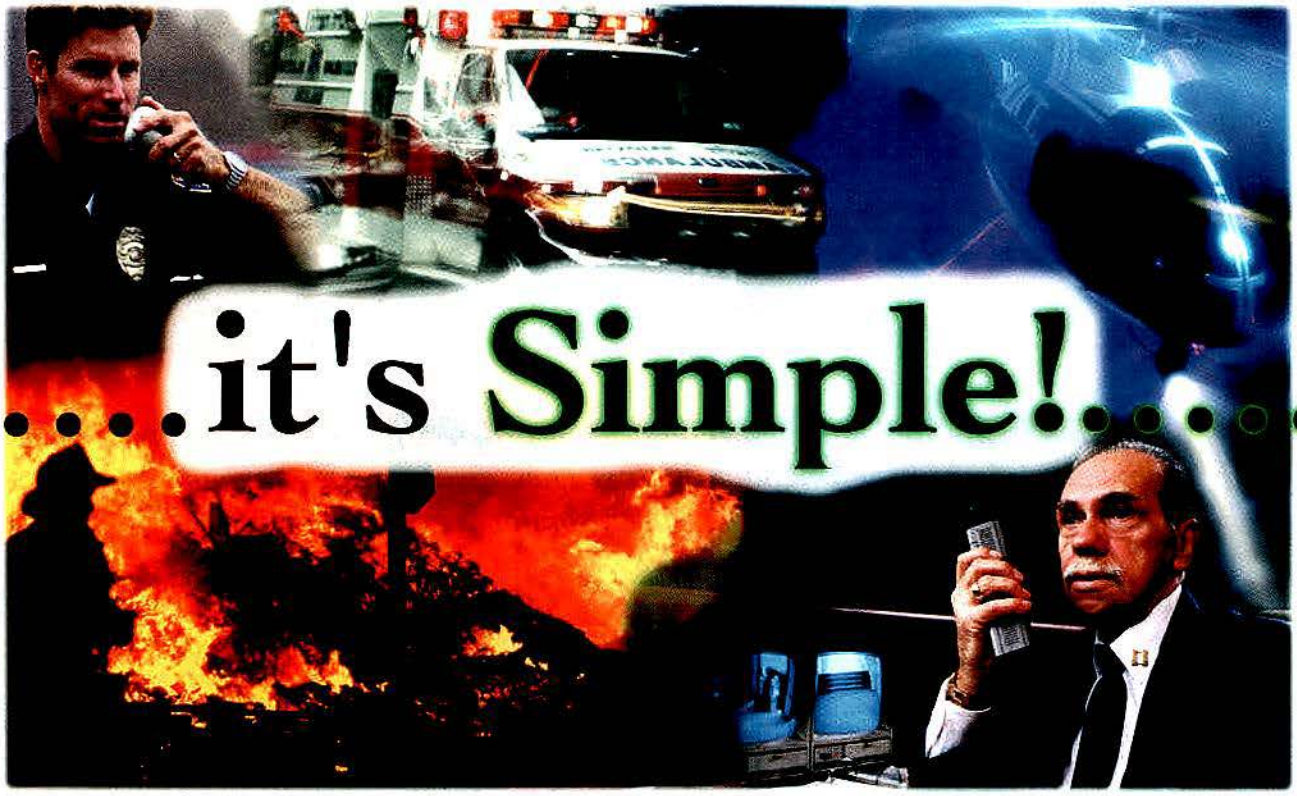
Over time, the clay increases in density, adhering to the rod surface and creating an excellent conductive medium with the surrounding soil. The clay is non-corrosive, with a pH of 8.0, and also protects the rod from acids in the soil. The clay has a resistivity of 2.5Ω/m, which in conjunction with the electrolytic solution inside the pipe increases the overall effectiveness of the system. The system is designed to improve performance over time and provide a seasonal stability.

At the Harriman cellular site, four new holes were drilled for locating the new rods in a 100ft × 100ft base area. V-shaped notches were cut in the granite for placement of the ground wires, which were then covered with a concrete material.

Leary said one of the benefits of using the bentonite clay backfill material that Lyncole supplied is that it retains moisture and expands, so it is not as likely to wash away over time.

"This tremendously improved the grounding problem at this site," Leary said. "We got the ground resistance way down, below 10Ω, which is very good, thereby solving the lightning damage problem."

"The savings that come into play when using an efficient grounding system are that you're eliminating downtime when electronic equipment has to be repaired. Also, the high cost of replacement parts for damaged equipment can be avoided," Leary said. "Many companies think that they don't have the time or manpower to worry about installing a good ground, but this sort of thinking can get them into trouble in the long run."



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Benchmarking tools enhance wireless test and measurement for competitive analysis

Benchmarking tools are not only a means of rectifying specific network problems and ensuring ongoing quality. They also provide documentation of competitive advantage over similar wireless services.

By James Kobielus and Andrew Woessner

Competitive benchmarking tools are a new addition to the test and measurement arsenals of wireless carriers. These tools allow carriers to measure their quality of service (QOS) against competing cellular, personal communications services (PCS) and enhanced specialized mobile radio (ESMR) carriers in their geographic markets.

What is competitive QOS?

The importance of competitive QOS has grown as the wireless industry has matured and new licenses have been granted or auctioned to aggressive new carriers. QOS will separate the winners from the losers in the competitive wireless industry.

Before the turn of the millennium, high-quality audio performance from wireless systems will become a competitive necessity, something that subscribers will take for granted. Operators who fail to deliver acceptable audio quality performance—as measured by audio quality and other metrics—will rapidly lose customers to any of several competitors, be they traditional cellular carriers or the new breed of PCS, ESMR, wireless local loop (WLL) and mobile satellite service (MSS) providers.

The subscriber's ear is the final judge of any wireless telephone system. Customers *do not care* about network technology and engineering issues, such as time-division multiple-access (TDMA) vs. code-division multiple-access (CDMA). They just care about performance. They will have every incentive to switch competing wireless service providers, technology notwithstanding, in the same way that they already change their landline long-distance providers.

This means that wireless operators will have to increasingly focus on subscriber-perceptions of quality. They will need to concentrate their efforts on areas of competitive weakness, such as the incidence of noise and distortions due to radio frequency (RF) phenomena. Quality-related systems test, measurement and optimization activities will grow in importance.

QOS is a composite metric made up of several call-related factors that contribute directly to end-user satisfaction.

▶ *Call initiation* — When the subscriber hits "SEND," does the call go through? There are three possible results from hitting the "SEND" key:

❑ no-service areas — The call does not go through, and the subscriber has to wait until he or she reaches another coverage area.

❑ blocked calls — The call does not go through, and the subscriber has to hit the "SEND" key a second time.

❑ good initiations — The call goes through.

▶ *Call access* — Assuming a good initiation, how long did it take for the system to grant the subscriber access to a voice channel? This is not a critical factor unless access times exceed 15 seconds, at which point the subscriber starts to wonder if the phone is working properly.

▶ *Call quality* — Once the call has gone through, how clear, intelligible and

Kobielus and Woessner are product managers for LCC International, McLean VA. Email: *kobielus_james@lcc.com* or *woessner_andrew@lcc.com.*

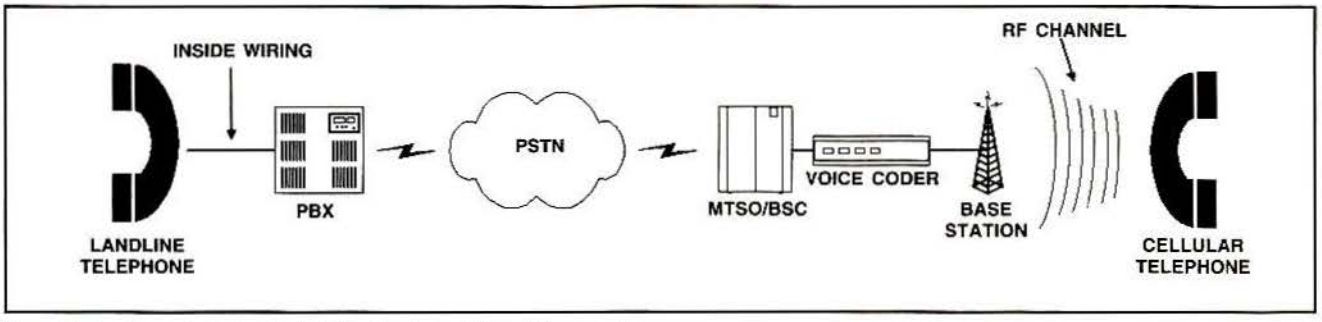
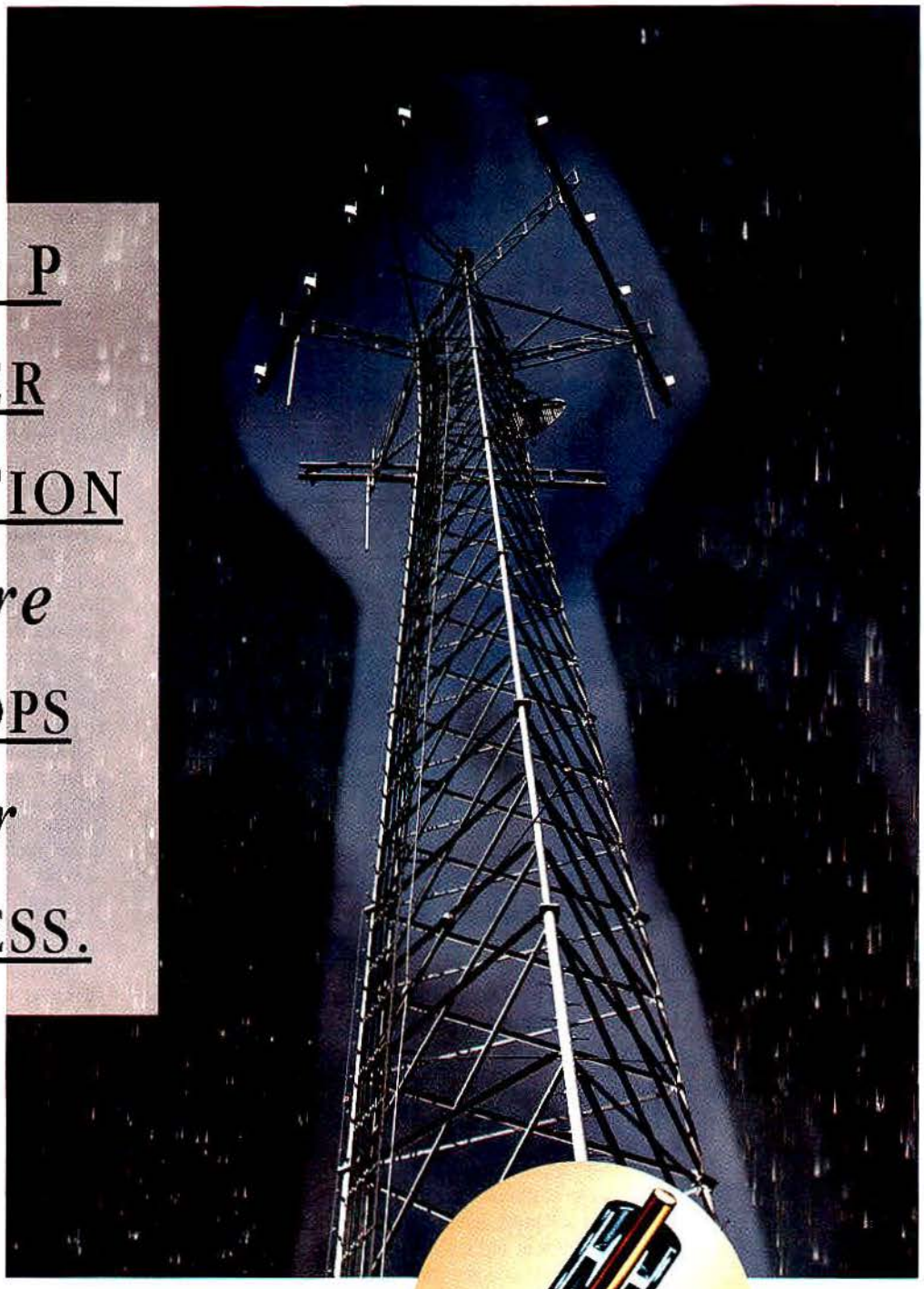


Figure 1. Configuration of a typical landline-to-mobile cellphone call.

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distortion-free is the audio transmitted between both ends of the connection? Graded on an MOS (mean opinion score) basis, there are five possible scores:

5 = excellent (no distortion detected).

4 = good (a little distortion detected; not annoying to the listener).

3 = fair (some distortion; slightly annoying).

2 = poor (significant distortion; annoying).

1 = bad (almost unintelligible; very annoying).

▶ *Call completion* — Assuming that audio quality is good enough (and does not annoy callers to the point where they abandon the call in frustration), was the call completed successfully? A call can end for the subscriber in two ways:

❑ normal end — The call ends on demand, when the caller presses the "END" key or replaces "on-hook."

❑ dropped calls — The system drops the call before the customer is ready, such as through faulty hand-offs.

Each carrier (indeed, each subscriber) will apply different weightings to these various QOS factors, depending on background, expectations, applications and the current state of wireless technologies.

The quality bar on all of these parameters will only get higher over time. Customers have come to expect continual improvements in wireless system performance in voice quality, due to technological advances and fierce competition. As wireless systems mature, customers will expect wireless voice quality on a par with traditional wireline telephone service.

Troubleshooting QOS problems

QOS and user satisfaction not only depend on the expectations of subscribers, but also on the intricate, end-to-end network infrastructure that supports a call. The perceived quality of audio transmissions in a wireless network depends on the performance of every system and component between the people speaking, including every switch, trunk, line, cross-connect and radio-frequency (RF) channel. It also depends on the quality of the subscribers' mobile terminals and how those phones are used.

When analyzing the quality of a given voice call, one must consider the technical environment specific to that call. Most calls placed from or to cellphones involve connections with the landline public switched telephone network (PSTN), as shown in Figure 1 on page 16.

Audio quality problems can be introduced at any of the following nodes or circuits:

❑ landline phone.

❑ inside wiring—including jacks, horizontal cabling, punchdown blocks and cross-connects—connecting the landline phone to an office private branch exchange (PBX).

❑ PBX, including trunks connecting to the PSTN.

❑ PSTN, including trunks connecting to the cellular operator's mobile telephone switching office (MTSO).

❑ MTSO.

❑ base station controller (BSC) or mobile system controller (MSC).

❑ voice coder.

❑ base station.

❑ RF channel.

❑ cellphone.

On this end-to-end call configuration, the only components typically under the wireless service provider's control are the MTSO, BSC or MSC, voice coder, base

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station, intranetwork trunk routes and, to a lesser extent, the RF channel. Service providers have little control over the type or quality of terminal equipment employed by their subscribers or over the subscriber's usage patterns or habits.

In most operational wireless networks, performance of infrastructure hardware—the MTSO, coder, trunks and base stations—is fairly stable. The basic network architecture is modified slowly over time, usually in a tightly controlled fashion subject to thorough testing and quality assurance. Consequently, infrastructure establishes a baseline quality to which customers, theoretically, usually adjust their expectations.

Isolating RF channel QOS problems

The one QOS factor that fluctuates constantly is the RF channel. Its reliability is affected by dynamic atmospheric, morphologic, geologic, hydrologic and traffic conditions present between fixed base stations and roving users. Fading, multipath, interference, noise and handoffs can degrade audio quality and cause it to fluctuate widely sometimes within a given phone call. One could argue that the bulk of users' reported audio quality problems on wireless networks can be attributed to dynamic RF conditions that were not foreseen or addressed adequately in the network design.

Many audio problems are caused or aggravated by RF factors and are commonly experienced in calls between landline and wireless telephone systems. The problems include: fading, static, noise, distortion, cross-talk, interference, clipping, echo and delay.

Wireless service providers usually address RF-related audio problems through regular modifications to their RF network design, such as adding base stations and repeaters, subdividing cells and sectors, and changing the tilt and beamwidth of transmitters.

No wireless carrier can claim to have eliminated RF-related QOS deficiencies from every hill, dale and office park in its market. Carriers do their best to maximize coverage, keep unwanted interference at bay, and minimize bit-error rates and dropped handoffs, but RF links are notoriously trouble-plagued. Bedeviled by tricky terrain, volatile weather conditions, and the ever-shifting landscape of fixed and mobile obstructions, RF propagation modeling is an inexact science—an engineer's rolling headache of network remodeling, retesting and reconfiguration. Each wireless carrier focuses on addressing a "Swiss cheese" pattern of weak zones in its system while searching for similar deficiencies in competitors' networks that can be called to a customer's attention.

Competitive benchmarking tools

Into this intensifying dogfight step the competitive benchmarking tools. To design our tool system, Benchmarker, we identified three fundamental tasks the system would have to perform: emulation, comparison and analysis.

▶ *Emulate the subscriber* — The benchmarking tool should automatically place and receive wireless phone calls; take QOS measurements on those calls (initiation, access, quality and completion factors); geolocate QOS measurements with a navigation technology, such as GPS; and log measurements with navigation coordinates.

▶ *Compare access protocols, bands, and service providers* — The tool should

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place calls and take QOS measurements on all wireless access protocols, bands, and service providers in a given geographic market. This would enable "apples-to-apples" QOS comparisons across different service providers implementing different technologies. It should be possible to place multiple calls concurrently from the same mobile benchmarking tool to as many as eight wireless service providers, reflecting the number of available cellular, PCS, and ESMR (and, soon, mobile satellite) service providers available in a given geographic market. A full-fledged competitive benchmarking tool should support all of the following common digital and analog wireless protocols: AMPS, IS-54B, IS-136 (800MHz and 1.9 GHz), IS-95 (800MHz and 1.9 GHz), GSM (900MHz, 1.8GHz and 1.9GHz) and Iden.

▶ *Analyze the data* — The tool should come with software that produces detailed management level reports, statistical graphs and location plots. Using these outputs to identify competitive strengths and weaknesses, a wireless carrier can then use the engineering data collected simultaneously with the competitive data to locate and resolve problems quickly.

Benchmarking tool architecture

A full-featured, competitive benchmarking tool requires mobile, landline, data collection and audio quality components.

▶ *Mobile unit* — This unit, typically installed in a "drive-test" vehicle, consists of multiple portable wireless phones and scan receivers covering all protocols and bands to be benchmarked; a navigation system, such as GPS or Travelpilot, to correlate measurement data with latitude and longitude coordinates; and a portable computer to set up measurement sessions, autodial the unit's cellphones, store collected QOS metric data and view data as it is being collected. Special mounting hardware is needed to seat the unit's chassis, and all portable phones, in the vehicle's trunk. The mobile unit draws power through a direct connection to the vehicle's battery.

▶ *Landline unit* — This unit, usually installed at a carrier's network operations center, MSC or MTSO, consists of landline phones that automatically (via computer scripts) dial or answer calls to and from the cellphones in the mobile unit. This simulates the typical mobile-to-landline configuration of most wireless calls. Whereas the mobile unit collects QOS data on the downlink, the landline unit collects corresponding data on the uplink of a call. Time synchronization ("handshaking") between the landline and mobile units is necessary to merge and correlate the resulting data to produce a composite portrait of wireless QOS.

▶ *Data collection, analysis, post-processing and reporting* — This requires software with geographic information system (GIS) capabilities. As previously discussed, this software should support collection, correlation, analysis and display of QOS data from uplink and downlink QOS data.

▶ *Audio quality measurement* — Both the mobile and the landline units should contain audio quality measurement modules, usually based on digital signal processing (DSP) technology, that produce MOS-like ratings of downlink and uplink audio quality on calls.

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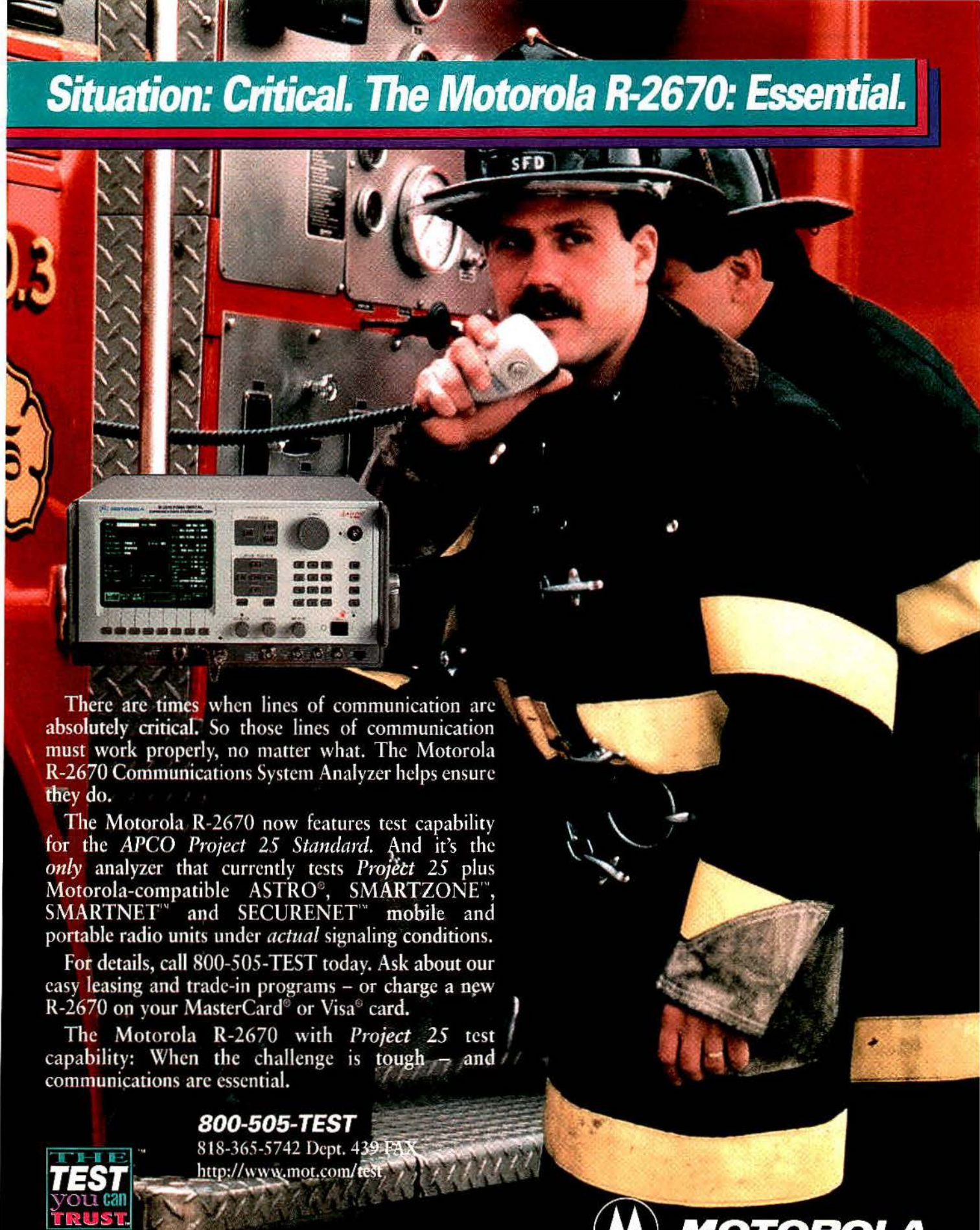
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module, called Auryst (aural analyst) assesses acceptable voice quality measurements in both digital and analog wireless systems based on validated user audio perception. The module measures wireless network voice quality as it would be perceived by the average listener. The module generates audio quality scores (AQS) on a scale of 1 to 5, as previously discussed, that are highly correlated (>95%) to known differential MOS (DMOS) data validated by Comsat Laboratories, which performs listener evaluations.

The audio quality module is based on an LCC-developed model (patent pending) of auditory perception that is derived from wavelet decomposition theory and accounts for auditory nerve-firing rates. The model uses critical band analysis and focuses on elements of speech and sound that are critical to user perception, such as frequency sensitivity, time resolution, masking phenomenon and intensity.

The audio quality module uses built-in reference speech samples—male and female—that are transmitted through the wireless system to establish a standard of acceptable voice quality. Speech samples are of phonetically balanced Harvard sentence-pairs to ensure that the audio quality measurements are taken on a representative phonemic sampling. Using high-speed DSP technology and a custom filter bank, the module can analyze and quantify distortion between reference and impaired samples in real time. Alternately, this information can be collected for mapping, post-processing, analysis and reporting in a Windows-based, post-processing application.

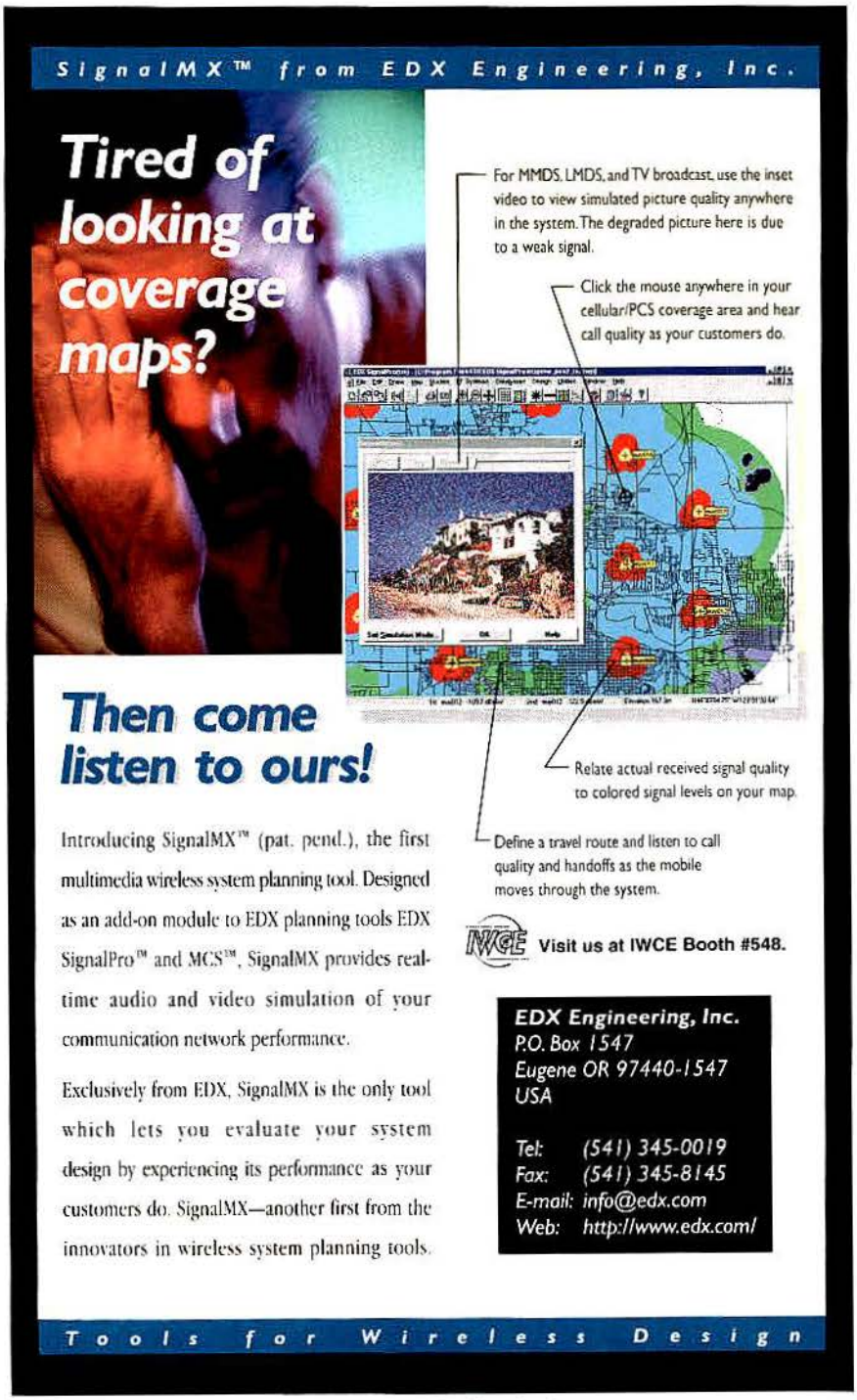
The module is used to generate "source-referenced" AQS metrics, which are analogous to source-reference DMOS. Source-reference AQS measures RF- and coder-impaired speech against "clean," pre-coder source speech. This is useful for characterizing the quality, including coder- and RF-related impairments, of calls on a single wireless system. Figure 2 on page 26 illustrates how the module computes an AQS.

AQS is measured in simplex mode, on either the forward or reverse channel, at any point in time during measurement. In addition to AQS, the audio quality module measures various follow-call parameters and call statistics, such as the incidence of call setup failures, busy signals, dropped calls, hand-off exceptions and completions.

The audio quality measurement module is designed to work with the leading digital and analog wireless protocols. RF engineers can receive and merge uplink and downlink measurements for audio quality, thereby supporting assessment of the baseline quality of an entire system. Moreover, engineers can use the technology to compare the quality of their service with that of competitors—regardless of which technology the competition uses.

The Benchmarker system measures audio quality on as many as eight digital or analog networks simultaneously. The landline audio quality measurement module performs uplink quality measurements on tones received from the mobile unit, while the mobile devices measure downlink audio in similar fashion, by measuring audio or tones transmitted from the landline unit.

Test calls can be initiated and answered automatically by either the landline or mobile unit. The landline unit module is capable of unattended, script-driven operation for each analyzer that controls



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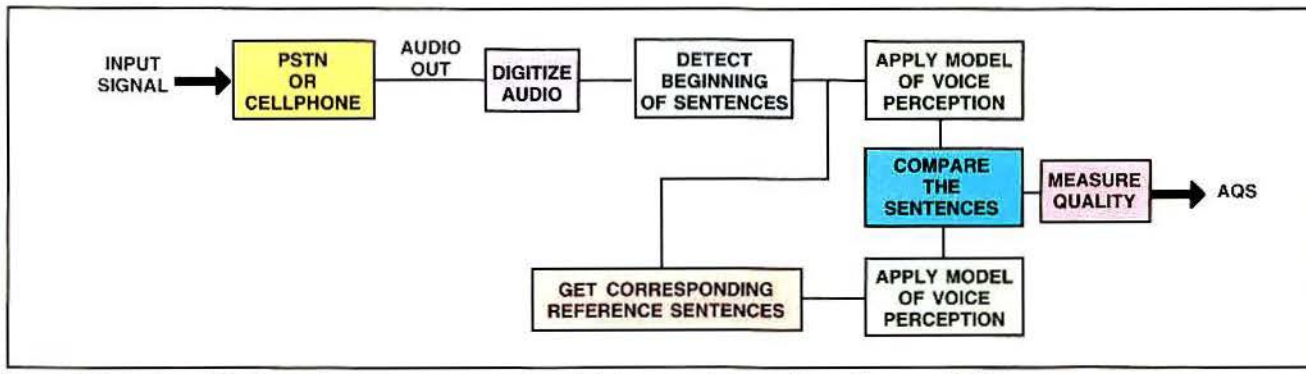


Figure 2. Method used by the audio quality measurement module to compute an audio quality score (AQS).

calling and answering, and it can be located for call termination at a mobile switching center or at a standard public-switched telephone network (PSTN) line interface. The landline unit supports an interface to the analog North American PSTN access loops and to international digital phone systems.

Ongoing benchmarking

Competitive benchmarking is an important activity that is of common interest to engineering, marketing, and executive-level personnel. Benchmarking is often used to set engineering goals and guide network expansion and optimization activities. Benchmarking must be based on valid methodologies that ensure that resultant data is clear and easy to interpret by all parties. To work through the complexities of a benchmarking operation, carriers should expect the benchmarking provider to offer tools, methodology and training.

▶ *Benchmarking tool* — The tool must support all of the carrier's benchmarking requirements, as discussed above, and be easy to install, use, administer and maintain by engineering staff. Ideally, the tool should output data to RF post-processing and analysis packages that carrier personnel are already using.

▶ *Methodology development* — Without appropriate data collection and analysis procedures, the competitive benchmarking results obtained can be extremely misleading. Benchmarking procedures must mesh with the carrier's system engineering and field operations and be capable of being carried out consistently, over time and across markets, by carrier personnel and engineering consultants. Better results can be obtained from benchmarking tools when they are bundled with consulting services that show the carrier's engineering staff how to make the most effective use of the equipment, analyze the benchmark data, and use those analyses to modify and optimize their systems.

Benchmarking procedures must mesh with the carrier's system engineering and field operations and be capable of being carried out consistently, over time and across markets ...

▶ *Documentation, training, and support* — Benchmarking tools and operational procedures must be presented to carrier staff through intensive, upfront training. The provider must be able to supply ongoing remedial training and in-service support. Well-organized, easy-to-read course materials, user manuals, application notes and service bulletins should be provided.

Effectively implementing a complex measurement system requires a carrier to rethink how it monitors its RF networks and to reconfigure support systems accordingly. The measurement system should include a landline unit, a mobile unit, and data collection, analysis, post-processing and reporting software with GIS capabilities.

Conclusion

Competitive benchmarking solutions provide the hard QOS data demanded by today's maturing, competitive wireless industry. With this data, wireless operators can perform intelligent optimization of their networks. Instead of simply looking for problem areas in their networks, they can look for areas of competitive weakness. In this way they can better prioritize which network problems need to be addressed and better answer the question of "How good is good enough?"

Supplying the data "ammunition" for quality "shoot-outs" between rival carriers, these tools are catalysts for raising industry-wide QOS levels to new heights. Subscribers—and the industry as a whole—can only benefit from this renewed attention to service quality.

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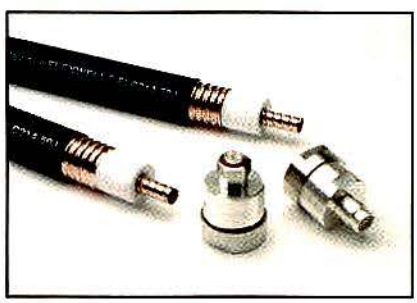


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UHF trunking: Promised land?

Private radio system users and commercial operators, pushed and prodded by consolidation and auctions, may view 450MHz–470MHz as the last bastion in which to operate. Manufacturers are keen to respond to new growth with new products.

By D.A. Keckler

The growth of specialized mobile radio (SMR) over the past 15 years largely derived from activity in the 800/900MHz bands, where trunking was allowed by the FCC and for which popular trunking protocols and equipment were created by major manufacturers such as Motorola, E.F. Johnson and Ericsson and supported by many smaller companies.

Over the past three years, most of 800/900MHz, through consolidation, buyouts and government auctions, now lies in the hands of a few large carriers, particularly enhanced SMRs (ESMRs). However, radio people are an entrepreneurial breed, and many service providers who handed over their frequencies are itching to reprise their former successes. Private industrial radio needs more airtime as well, but little spectrum is available above 800MHz.

The "refarming" process for the lower frequencies instigated by the FCC about five years ago created uncertainty. This, along with spectrum freezes above 800MHz and auctions in several bands, tied the hands of private and commercial licensees as well as manufacturers.

Refarming is over; it's time to plant.

Replacement of Part 90 rules to revise the Private Land Mobile Radio (PLMR) services went into effect in October 1997, with three particular effects:

- ❑ All the former radio services have been consolidated into two pools, Public Safety and Industrial/Business, with frequency coordination competition for most of the latter. This reduces the types of service to four: conventional and trunked for each of the two pools. All other small radio service names are gone.
- ❑ Narrowband standards have been adopted for channel spacing.
- ❑ Trunking is now allowed in the 150MHz and 450MHz bands.

Keckler is features editor.

Private carriers and community repeater owners need the capacity trunking can provide. Trade associations have already noted that they don't expect or *want* to see a "replay" with UHF of the 800MHz exclusivity created by the FCC. As Mark Crosby, president of the Industrial Telecommunications Association has said of 450MHz, "It's all we have in the immediate future. Right now, for the short term of three to five years, we've got to look at this band."

Back in the saddle again

Dislocated SMR entrepreneurs now have the opportunity to set up multichannel trunked networks, as they did at 800MHz, by acquiring conventional UHF repeaters and converting to private carrier status. Analog SMRs, non-competition clauses not withstanding, can get back in business. They can again handle dispatch customers who cannot afford, and do not need, services as provided by large consolidator ESMRs.

The frequency coordination load since October has been heavy. Everyone is heading for the promised land—below 800MHz. As noted in this month's editorial *(see page 4)*, like the opening of the Old West, trunking may have effect of making incumbent conventional users identify with the Indians—urged to migrate or to sell out.

To continue the Old West analogy, UHF already has been "homesteaded" to some extent by "Sooners," who, based on FCC staff opinions and a lack of specifically proscriptive regulation, built trunked systems in most major U.S. markets. Operators simply observed the old rule of "monitor before using." What the FCC was busily trying to determine was already obvious to radio people: existing, affordable trunking equipment and no exclusivity—in short, plowable land. With the advent of the FCC's Second Report and Order (SRO) on Part 88 last October, however, the territorial government arrived, and "Boomers," not "Sooners," are the order of the day.

No more 'wide-open spaces'

The original separation for 450MHz–470MHz was 100kHz, which was reduced to 50kHz and then to 25kHz in 1967. In 1970, special low-power 12.5kHz offset channels were introduced. Refarming reduces separation for channels from 15kHz or 25kHz to 6.25kHz over the next seven years. Primary frequency licensees who do not change their systems are unaffected for the present and can replace system components with equally wideband equipment (although it is expected that everyone will migrate to narrowband over time). Manufacturers' new applications for type-acceptance of affected radio devices must now comply with 12.5kHz for UHF, which will become 6.25kHz after the year 2005.

Circling the wagons

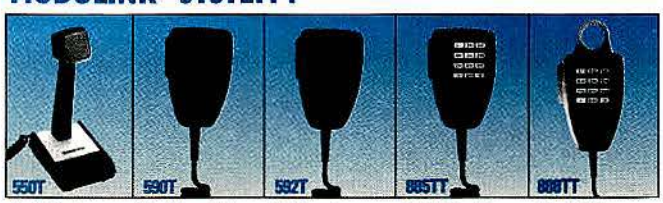
Although UHF trunking is now "recognized and authorized" by the FCC, there are still several details hanging. The rules do allow trunking of existing and new channels, but they require potential system operators to obtain exclusivity for their intended service area. This is currently to be accomplished by securing written permission from all co-channel and adjacent channel licensees whose 39dBu service contours intersect a 70-mile radius from the proposed trunking station. If you have five channels, this means everyone else on those five channels, and the offsets to those five channels, in that radius. The consent agreements are to be submitted to the frequency coordinator and to the FCC with the license application.

Industry reaction to this rule has been, well, reactive. The requirement is difficult at best in congested metropolitan areas. Frequencies below 512MHz are mostly held by private users, whose decision to accept or reject interference may be uninformed. By definition, centralized trunking requires exclusive channels, and

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other users would have to be urged to convert their systems to trunking as well. Manufacturers, system operators, trade associations and communications attorneys alike have characterized the rule as "burdensome," "unlikely," "impractical" and some other terms I won't repeat here. However, the industry has responded in a more positive fashion with several proposals to the FCC which may gain favor.

One proposal is to use interference-to-service contours instead of a radius to determine true co-channel and adjacent-channel licensees. Supported by AAR, AMTA, APCO, ITA, FIT, PCIA, UTC and Kenwood Communications, this method could determine actual interference potential, but would still require coverage studies. Operators might have to consider mergers, payoffs, frequency swaps, and relocation as solutions to head-to-head inference. An additional tool would be to do a search of dead licenses, verify abandonment and request the FCC to cancel them, which takes about six months.

SBT, in a proposal supported in substance by PCIA, has recommended a developmental license for a fixed period (SBT, two years; PCIA, one year). Interference would be the responsibility of the

The joy of trunking

Trunking at 800MHz began in the 1970s. A computer-dependent system to use spectrum more efficiently, trunking takes advantage of the recurrent idleness of transmitters. A pool of channels is shared among a large group of users who are automatically switched to an inactive channel. In a five-channel trunking system, with each channel loaded 50%, channels can be accessed 88% of the time. In a 20-channel system, with 50% loading, acccess is virtually constant.

Trunking 101

Trunking falls into two basic types: *centralized* and *decentralized* trunking.

▶ *Centralized trunking* — There are two classes of centralized trunking. One uses a dedicated data command channel as a control channel, which all inactive units monitor, leaving the remaining channels (four, in a five-channel set) open for communications. Base station repeaters are governed by a microprocessor, the *system central controller.*

In the other class, logic-trunked radio (LTR), control data is sent out on the frequency that is the next available channel. Units assigned to the home channel use their home frequency. If it is busy, subaudible digital signals switch a user's fleet to any available channel. Each repeater contains a logic module responsible for signaling on its own channel, and the module in each repeater shares information with all other logic modules through a coaxial data bus.

▶ Decentralized trunking — Centralized trunking is thought by some to be impractical for VHF and UHF because of a lack of exclusive channels in those bands. Decentralized trunking monitors or scans. *Scan-based* trunking protocols will work on non-exclusive channels. Prior to the completion of refarming, many users wanted spectrum efficiency and features of 800MHz trunking, but the FCC prohibited the use of 800MHz-type centralized interconnected base stations and switches in VHF and UHF systems. Protocols were created to go around this limitation by putting the trunking functions into VHF and UHF mobile and portable units. The protocols incorporated dispatch trunking capability using standard VHF or UHF repeaters. With these scan-based systems, channel assignment is determined by the logic in the mobile, not by a controller at the repeater site. Because scan-based trunking is not "centralized," FCC frequency coordination requirements were not considered to apply.

UHF trunking advantages over 800MHz trunking include adequate coverage with more range than 800MHz. Repeaters for VHF and UHF cost less than comparable 800MHz systems. Mobiles and portables are also generally less expensive. Private carrier licensees that convert conventional 450MHz repeaters to trunked operation can load more customers with existing equipment.

The advantages of any trunked system include automatic clear channel selection; privacy; channel exclusivity; and selective calling.

Networking and technology

Digital technology has led to the development of networks of multiple trunked systems to provide wide-area coverage with features such as connectivity, roaming and network management. Digital networking can be accomplished through multisite controllers, from companies such as Ericsson.

Site controllers for multiprotocol trunking and networking, from companies such as SmartLink, circumvent problems with proprietary formats and allow analog systems to compete with ESMRs. Multiprotocol systems enable frequency crossbanding, call hand-off, and management of customer access and use.

Transcrypt International/E.F. Johnson introduced its LTR-Net distributed trunking technology and its 2000VX repeater in 1997 as a basis for networking systems. The LTR-Net trunking protocol allows over-the-air compatibility with existing LTR subscriber units. Kenwood Systems Group released a 100W UHF repeater in 1997, compatible with KSG controllers, for trunked and conventional systems for UHF.

A networking protocol introduced in 1997 by Trident Micro Systems is also pushing the movement to UHF trunking. The Passport NTS trunking protocol, backward-compatible with LTR, supports wide-area networking, roaming between networked sites, selective calling and telephone interconnect.

Trident's protocol permits crossbanding among 220MHz, 450MHz and 900MHz. Protocol-equipped radios use direct frequency assignment to determine operating frequency. Trident announced free licenses to qualified manufacturers, and in a joint announcement at AMTEX in November, 1997, five manufacturers (Kenwood Communications; Ritron, Standard Communications and SEA), lined up to support the protocol. All the companies are manufacturing equipment that supports Passport or a hybrid of Passport, LTR and conventional UHF.

Additionally there several new releases of UHF trunking portables and mobiles from companies such as Midland USA and Uniden.

Numerous exhibitors will have UHF-trunking-related system and user equipment at IWCE, April 22–24. The product guide on page 34 lists equipment introductions in the exhibit hall.

developmental licensee. If no problems occur, the license converts to primary status.

SBT's proposal in its Petition for Reconsideration is a similar plan to licensing for 43MHz paging, which can interfere with TV reception. Therefore, there is a precedent in the existing rules.

At presstime, industry sources indicated that the FCC has some sensitivity to modifying the current 70-mile rule, and may adopt a Memorandum Opinion and Order (MO&O), as early as the second quarter of 1998, using interference-to-service contours as the guide.

Smoky signals

The wording of the refarming SRO also creates a technical vocabulary problem. The *text* of the refarming order partly discusses *centralized* trunking, but the codified concurrence *rules* just say "trunked operation," They don't specify centralized or decentralized.

Complicating this, in the past the FCC has issued a citation for operating a station authorized for conventional operation in a trunked mode above 512MHz.

Until the SRO, nothing in the FCC rules either prohibited or expressly permitted trunked operation below 800MHz. Informal bureau policy has been to disregard trunking below 512MHz, provided there is no interference. Operators of current and planned decentralized trunking systems (and coordinators) are left hanging by the wording as to whether a license for a trunked system requires concurrence from adjacent licensees regardless of system type—centralized or decentralized.

The Land Mobile Communications Council (LMCC) in trying to address this, has come up with a recommendation to make the actual technology irrelevant and to leave how the system is licensed up to the applicant. Systems would be coded, "YG" for a trunked and "IG" for a non-trunked or conventional system. The LMCC plan, currently undergoing a council advocacy vote, says from a frequency coordination standpoint, or from a commission spectrum management standpoint, "We don't want to get into asking what kind of decentralized system you have; you license it the way you think that's best." An operator who has a decentralized system that monitors would not need clearance. If the system is decentralized with scan trunking in the unit, it could be licensed either as an IG or as a YG. The YG (trunked) license would still be liable to concurrence.

"Now, the flexibility is on the part of the industry," said ITA's Crosby, who is also an officer of the LMCC. "The industry can license however they want. So that if somebody had an LTR, that needs an exclusive YG, you license one channel as YG for the control channel, and all the other ones are IG. It doesn't matter to us—we [frequency coordinators] don't care. The coordinators don't want to get into 'Well, if you have this, then you've got to do that' ... The LMCC wants to give that to the commission—we don't think that needs a rule change."

At the show...

An "Update on UHF Trunking" panel discussion will take place at IWCE on Wed., April 22. Chaired by Mark Crosby, ITA president, the panel will include Rhett Grotzinger, Trident Micro Systems; Joe Watts, Kenwood Communications; Eliot Terborgh, SmarTrunk Systems; and David Terman, Champion Communications Technology.



Now it's easy to use two way radios in high noise. Just add a DAVID CLARK Noise Attenuating Headset and Radio Adapter Cord to your two way radio and ***you will...***

eliminate the hazard of clumsy and confusing hand signals...
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T-1

Circle (13) on Fast Fact Card

IWCE '98 Show Guide

More than 325 mobile communications equipment manufacturers, distributors and service providers will convene at the Las Vegas Convention Center, April 22–24. Products on display will include antennas, accessories, cellular items, data communications, lightning protection products, mobile and portable radios, paging equipment, tone signaling equipment, towers and other wireless-related items.

This section is designed to help you plan your time at the Las Vegas Convention Center. Sections include:

❑ a pull-out map on page 32A, including a list of exhibitors and booth numbers.

❑ a summary of exhibitors' products and services on display that begins on page 34. Exhibitors listed include those who submitted information as of press time. The names of exhibitors that are advertisers in this issue are highlighted in blue ink, with page references to their ads.

Symposia at the Expo will cover mobile communications industry opportunities and technical topics. Some highlights of the show include:

❑ **A public policy panel**. On Wednesday, a three-way panel composed of the FCC staff, House and Senate staff for communications issues and representatives of industry associations will discuss hot topics such as auctions, license freezes, spectrum allocations, enforcement and the role of mobile radio in American business.

❑ **A dealer lunch forum**. On Thursday, a progressive lunch will allow dealers to have round-table discussions of key business issues like finance, competition, growth, impact of new services, regulations and emerging technologies, operations and marketing. The announcement of a major FCC initiative supporting fair competition is expected at the luncheon. Reservations are required—call fax-on-demand at 800-601-3858.

❑ **An 800MHz incumbent operator rights session**. On Thursday, after lunch, the ramifications of the spectrum relocation in progress for the 800MHz SMR band will be discussed. This session promises to be lively.

❑ **A special showcase demonstration** on using the **Internet** for customers service.

❑ **A product application showcase** with presentations from 22 companies that are free and open to the public.

Over the years, many new technologies such as paging, cellular and PCS, have developed from traditional mobile radio technologies. New applications of wireless technology continue to emerge. IWCE '98 takes you to the forefront of the latest technologies, introduces you to new specialty applications and helps you develop effective strategies for the future. IWCE's leadership into new markets promises to make the 1998 show an unparalleled mix of information, innovation and inspiration.

Among the attendees who will benefit from the show are dealers; resellers; operators; commercial end-users; community repeater operators; two-way, SMR, paging, cellular and PCS base station operators; engineering/consulting firms; and mobile communications managers for public safety agencies, industrial plants, national/state/local government, military agencies, transportation companies, petroleum companies and public utilities.

Mobile Radio Technology will be in Booth 1300. See you at the Expo!

Product Application Showcases

The product application showcases offer an in-depth look at the latest product offerings. You'll be able to compare features, services and technologies across the board.

Mobile Radio Showcase

Wednesday, April 22

10:30 a.m.:
Site selection & performance
- ❑ TX RX Systems
- ❑ Lyncole XIT Grounding
- ❑ PolyPhaser
- ❑ Lightning Eliminators & Consultants
- ❑ Hark Tower Systems
- ❑ Barnett Engineering
- ❑ CommScope
- ❑ Argent RF Division

1:00 p.m.:
Voice & data communication equipment
- ❑ Intraplex
- ❑ King Communications USA

2:30 p.m.:
Dispatch, short messaging & paging
- ❑ SpaceCom Systems
- ❑ WPCS
- ❑ Helper Instruments

3:30 p.m.:
Public safety applications
- ❑ Cerulean Technology
- ❑ Cadex Electronics
- ❑ King Communications USA

Specialty Wireless Showcase

Thursday, April 2

11:30 a.m.:
Site-to-site communication & trunking
- ❑ IDA
- ❑ SmarTrunk Systems
- ❑ Transcrypt
- ❑ SmartLink
- ❑ Adtran
- ❑ SpaceCom Systems

1:00 p.m.:
Fleet management: AVL, tracking, automatic data, GPS
- ❑ IDA
- ❑ Mentor Engineering
- ❑ King Communications USA
- ❑ Cadex Electronics

3:00 p.m.:
Internet services for dealers & service shops
- ❑ Bobby G. Thompson & Associates

IWCE '98 Schedule-at-a-glance

Monday, April 20

7 a.m.–5 p.m.	Registration open
8 a.m.–5 p.m.	Base station workshops: Fundamentals of Radio Communications

Tuesday, April 21

7:30 a.m.–5 p.m.	Registration open
8 a.m.–5 p.m.	Base station workshops: Testing the Base Station RF Subsystem
8 a.m.–5 p.m.	*RF Design* seminar series
8 a.m.–5 p.m.	PCIA's Licensing Skills & Techniques Seminar

Wednesday, April 22

7:30 a.m.–5 p.m.	Registration open
8 a.m.–5 p.m.	*RF Design* seminar series
8:30 a.m.–9:45 p.m.	Opening general session
9:50 a.m.	Ribbon-cutting ceremony
10 a.m.–5 p.m.	Exhibits open
10:30 a.m.–12:15 p.m.	Business: Inside the Industry Associations Regulatory: RF Interference Solutions Public safety: Disaster & Emergency Public Safety Services Technology: Update on UHF Trunking Applications: Utility SMR Systems
10:30 a.m.–4:45 p.m.	Mobile Radio Showcase
1 p.m.–2:45 p.m.	Technology: What's New in Paging Applications: Low-power Radio Applications Regulatory: Public Policy Roundtable
1 p.m.–5 p.m.	Base station workshops: Maintaining & Troubleshooting the Transmission Chain
3 p.m.–4:30 p.m.	Public safety: Implementing Mobile Data in Public Safety Applications Business: Challenges to Success in International Business Applications: Specialty Wireless Applications Open New Opportunities
5 p.m.–7 p.m.	International reception (invitation only)

Thursday, April 23

7:30 a.m.–5 p.m.	Registration open
8 a.m.–noon	Base station workshops: Maintaining Reliable Base Station Power
8 a.m.–5 p.m.	*RF Design* seminar series
9 a.m.–10:15 a.m.	Business: Success Part 1: Strategic Planning Regulatory: Update on FCC Auctions & the Universal Licensing System Technology: A Look at Global Commercial Trunking Applications: A Look at Tomorrow's Wireless Communications Systems
10 a.m.–5 p.m.	Exhibits open
11:30 a.m.–4:45 p.m.	Specialty Wireless Showcase
11:30 a.m.–1 p.m.	Dealer's Lunch Forum with FCC announcement
1 p.m.–2:15 p.m.	Business: Success Part 2: Operations Public safety: Contracting for Public Safety Services Technology: Adding Mobile Data to Your System
1 p.m.–3:45 p.m.	Technology: Battery Technology, Grounding & Surge Protection Regulatory: 800MHz Incumbent Operator Rights
2:30 p.m.–3:15 p.m.	Business: Successful Business Management Part 3: Profitability Technology: Working with Wide-area Dispatch-only Networks

Friday, April 24

8 a.m.–1 p.m.	Registration open
8 a.m.–5 p.m.	Base station workshops: Understanding & Maintaining the Wired-to-Wireless Link
8 a.m.–5 p.m.	*RF Design* Seminar series
9 a.m.–10:15 a.m.	Business: Success Part 4: Growth Regulatory: Measuring RF Emission Radiation Compliance Public safety: Public Safety Information Systems Applications: Custom Mobile Data Applications
9 a.m.–1 p.m.	Exhibits open
10:30 a.m.	Closing general session

Products, services

The following preview information was supplied by the exhibitors. Information for listings and booth numbers is accurate as of press time and is subject to change. See map page 32B for complete exhibitor list.

A.C. Data Systems **Booth 1058**
Existing products
Surge Blox modules—stackable and upgradable surge protection devices; Surge Blox panels—Surge Blox modules in a patented assemblage with a variety of voltages and sizes available; AC2 series individually fused and alarmed MOVs; Telco, data, T-1 and E-1 suppressors; SPECTX surge-protected energy center/transfer switch.
Circle 201

A.W. Enterprises **Booth 123**
Existing products
Carrying cases and holsters for two-way radios; pagers and pager electronic equipment.
New products
Cases for 1998 radios and headsets including I-600 by Nextel.
Circle 202

Adtran **Booth 1562**
Existing products
Digital communications systems for telephone service providers, end users and original equipment manufacturers; broad line of networking equipment is for T1/HDSL, ISDN, DDS/frame relay and switched 56 digital transport access.
New products
Tracer digital spread-spectrum radio, a license-free wireless dual T1 transmission system that delivers two T1s, providing point-to-point wireless connections of as far as 30 miles. It operates in the FCC's unlicensed 2.4GHz to 2.4835GHz ISM (industrial, scientific and medical) band. Tracer is for high-speed connections for voice, data or video applications, linking remote sites and establishing communication links for emergency/disaster recovery, special events broadcasting or voice/data infrastructure for industrial, utility, public safety and public service companies.
Circle 203

Advance Label & Tag **Booth 1333**
Existing products
Custom nameplate labels for all wireless equipment; warranty and tamper-proof labels to prevent fraud; pager repair printing systems.
Circle 204 See classified ads

Advanced Charger Technology **Booth 551**
Existing products
Activator series of ultra-rapid two-way radio battery chargers, including the single-bay personal Activator (TBC-20) and the six-bay Activator VI (TBC 60). Charges an 1100mAh battery in about 30 minutes; eliminates memory effect, triples battery life and gives maximum capacity charge.
New products
Ultra-rapid in-vehicle Activator two-way radio battery charger, with same features as above.
Circle 205

AdvanceTec Industries **Booth 1122**
Existing products
Negative pulse reconditioning and chargers for cellular phones and two-way radios; pulse analyzers for NiCD and NiMH batteries; portable hands-free units for cellular phones.
New products
AT5000PA pulse analyzers; AT185HF portable/installable hands-free for digital Nokia; AT480HFD portable hands-free for digital Ericsson; AT585XTD portable/installable hands-free for digital Motorola.
Circle 207 See ad page 15

AEA, a Division of Tempo Research **Booth 1430**
Existing products
Hand-held SWR antenna analyzers; hand-held Cablemate TDR fault detector; Isopole vertical VHF and UHF base antennas.
Circle 208 See ad page 86

Aerotron-Repco Systems **Booth 2000**
Existing products
RDL series telemetry transmitters and receivers; NLR series spread spectrum radio modems; MPAC base stations; digital data systems; industrial automation; automated vehicle location systems.
Circle 209

AF CommSupply **Booth 955**
Existing products
Wireless communications equipment from more than 60 of the industry's manufacturers such as Andrew, Antenna Specialists, Celwave, Decibel, ICT, Maxrad, Times and PolyPhaser. Products include base station and mobile antennas, cable and installation accessories, communications site and test equipment, bench supplies and cellular accessories.
Circle 210

Air Comm **Booth 716**
Existing products
Reconditioned two-way mobile and portable radios; base stations and accessory items plus PL, DPL, Quik Call I-II reeds, filters and code plugs.
Circle 211 See classified ads

American Mobile Telecommunications Association **Booth 712**
AMTA: Association publications; membership; regulatory services; 220 publications and research services; TradeMap series.
Circle 212

American Nucleonics **Booth 813**
Existing products
Trailblazer interference cancellation system suppresses interference picked up by cellular, pager or SMR repeater/base station; it leaves the desired receive signal unaffected, while canceling interfering signals using a patented, proprietary adaptive correlation/decorrelation technique.
New products
Trailblazer/repeater interference cancellation system.
Circle 213

Andrew **Booth 1623**
Existing products
Products that serve land mobile, cellular and PCS markets: terrestrial microwave, base station, cellular panel and grid antennas; Heliax coaxial cable and accessories; towers and shelters.
New products
Grounding and surge arrestor solution; Heliax jumper cables and assemblies.
Circle 214 See ad page 48

Antenex **Booth 2023**
Existing products
Mobile, portable and base antennas for two-way radio, amateur radio, data telemetry, cellular, PCS, PCN and SMR communications.
New products
Black Phantom antennas; Discadoo: flat 800MHz/900MHz antennas; Skyhawk: high gain fiberglass base antennas; 1.8GHz and 2.4GHz yagi antennas.
Circle 215 See classified ads

Argent RF Division **Booth 249**
Existing products
RF safety products; consulting and training services.
Circle 216 See classified ads

Associates Leasing **Booth 6**
Existing products
Leasing, financing and insurance programs dealers and end-users of all types of communications equipment; special tests equipment an municipal financing; demo and rental equi ment; leasing of sales and service vehicles.
Circle 217

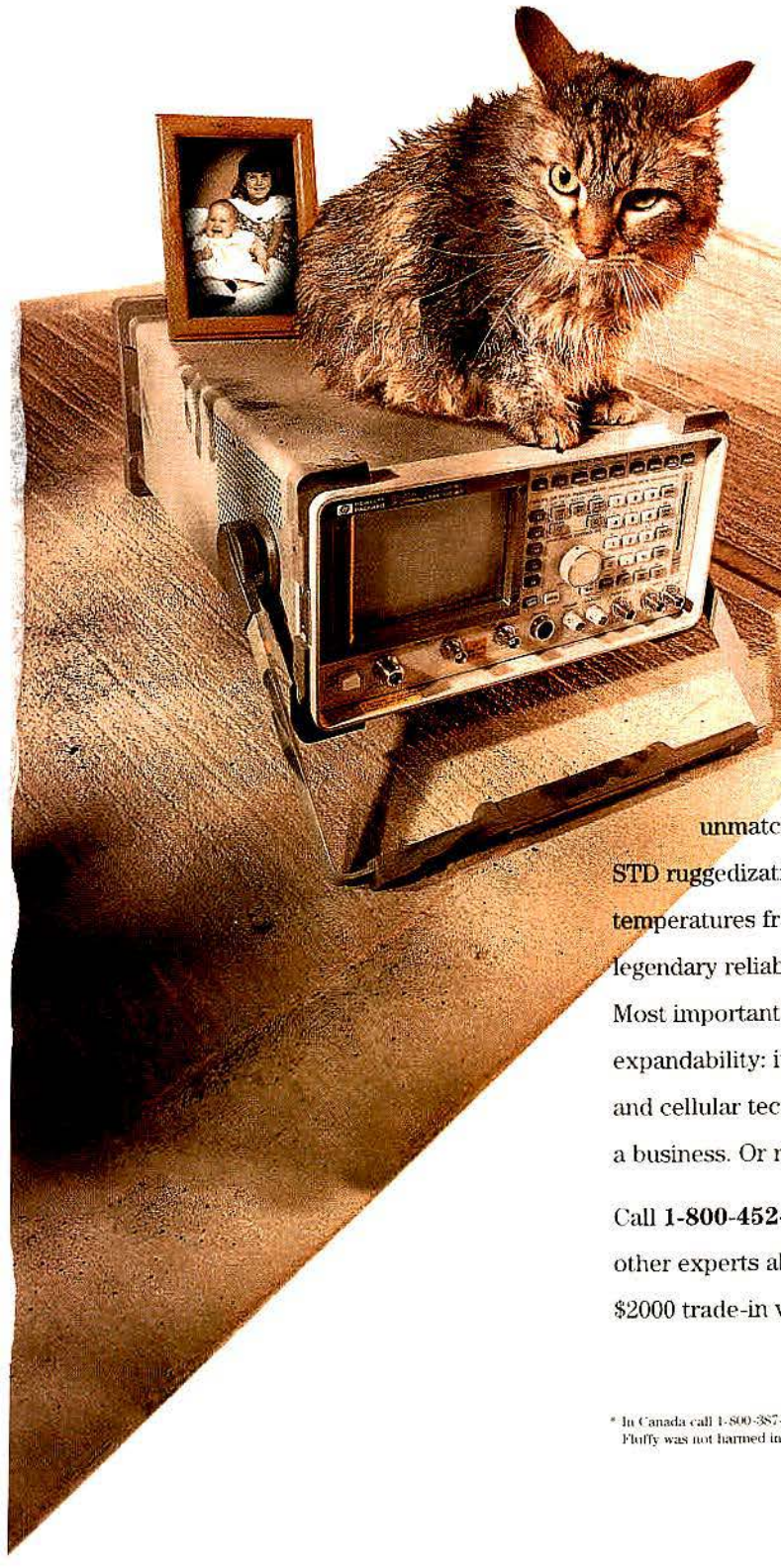
Astron/Antennaco **Booth 1153**
Existing products
Low-band VHF/UHF yagi antenna; MPD

October 2, 1996.

Bob Jensen had
a fire at his mobile
radio repair shop.

He had only a
few seconds to
save things.

Thanks for the vote of
confidence, Bob.



No offense, Fluffy, but the HP 8920A is irreplaceable, too. Because the HP 8920A service monitor provides the edge you need to survive in today's tough business environment. It offers unmatched accuracy (frequency to within .1 ppm). MIL-STD ruggedization means it can withstand shock forces up to 30 g's, temperatures from 0 to 50 °C, and humidity from 0 to 95%. With the legendary reliability of HP (20,000 hrs mean time between failures). Most importantly, the 8920A service monitor offers superior expandability: it can test everything from two-way radios to pagers and cellular technologies. Which is important when you're building a business. Or rebuilding one, as the case may be.

Call **1-800-452-4844;* Ext. 5119**. Talk to Charlie or one of our other experts about the HP 8920A and find out how you can get a $2000 trade-in value for your old service monitor.

* In Canada call 1-800-387-3154, program number TMU310. ©1997 Hewlett-Packard Co. TMSKD707/MRT
Fluffy was not harmed in the making of this ad. She's as rambunctious as ever, and enjoying Bob's new location.

Visit us at IWCE Booth 216.

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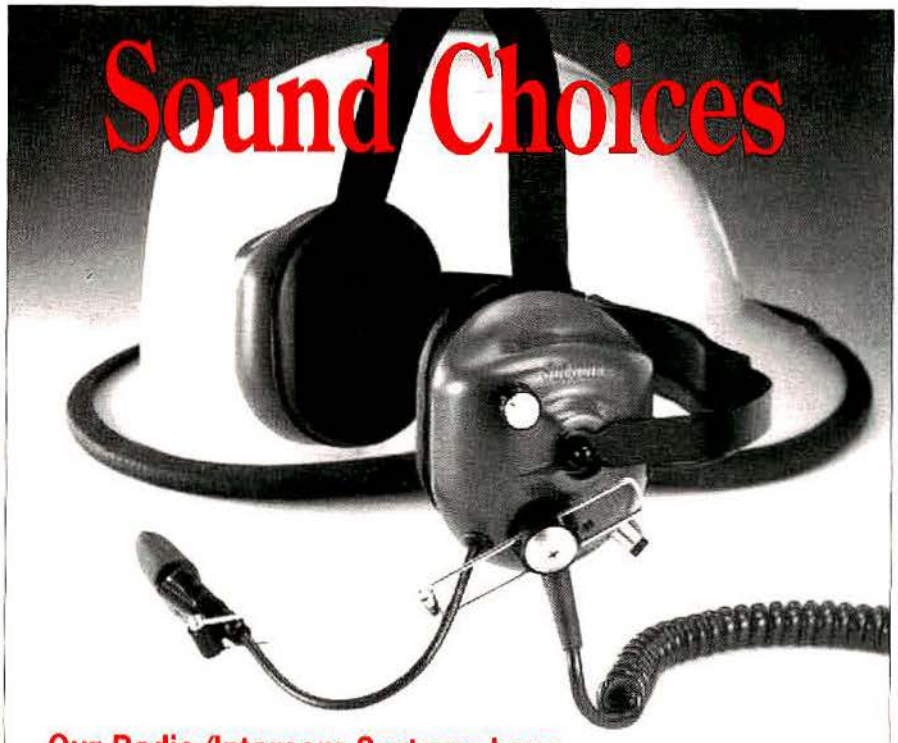
Circle (24) on Fast Fact Card

series power dividers; model D-228-4 dipole arrays.
New products
Model 155-6 VHF yagi antennas; model 220-4 200MHz series yagi antennas; model V-4600 omni antennas; model MPD series power dividers.
Circle 218 See ad page 25

Atlantic Solar Products **Booth 1660**
Existing products
Solar power systems; solar modules.
New products
Sunmate solar electric generators.
Circle 219

AVCOM of Virginia Booth 433
Existing products
Portable spectrum analyzers including PSA-65 series
Circle 220 See ad page 94

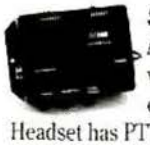
Avtec Booth 1223
Existing products



Our Radio/Intercom Systems have...

Performance Designed In

Meet NFPA standards with the best sounding noise attenuating headsets available, headsets that can also be used with your portable radios. Engineered RFI/EMI and ground loop protection. Product reliability developed through 22 years experience justifies our two year warranty, a benchmark for the industry.



System 900
A single radio model with basic features cuts cost not corners.
Headset has PTT and volume control; uses standard 1/4" phone plug.



System 930
A dual radio system designed for use with EMS vehicles. Offers simultaneous transmission, balance controls, intercom mute and more.



Cost Designed Out

All models are fully-assembled and easily installed. Our full line of single and dual radio systems ensures that you receive needed performance for the lowest cost.

Also Available:
- System 1300 with Split Audio for ARFF vehicles
- Pumper Panel/Driver Headset for vehicles not requiring intercom systems.

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Circle (25) on Fast Fact Card

DSPatch series consoles; color touchscreen mouse-integrated radio and telephone console systems; as many as 1,024 lines or workstations; supports directly connected T1 digital circuits.
Circle 221 See ad page 100

Best Case and Cellular Accessories **Booth 759**
Existing products
Cellular and paging accessories. Paging: housings, chains, leather cases and accessories. Cellular: batteries, saver and chargers, rapid chargers and leather cases.
Circle 222

Cartwright Communications **Booth 122**
Existing products
Infrastructure equipment; mobile and portable accessories; antennas; bench and test equipment.
New products
Wireless solutions cellular accessory rack; a retail merchandising system.
Circle 223

Cellular & Mobile International Booth 1300
Existing products
Published monthly, *Cellular & Mobile International* provides decision-makers with articles that examine the technologies, applications and equipment of the international wireless communications industry. The circulation of 10,000+ reaches system operators, dealers, distributors, engineers, large-volume end-users (including public safety buyers) and manufacturers around the world, including Asian, European and Latin American markets.
Circle 224 See ad page 75

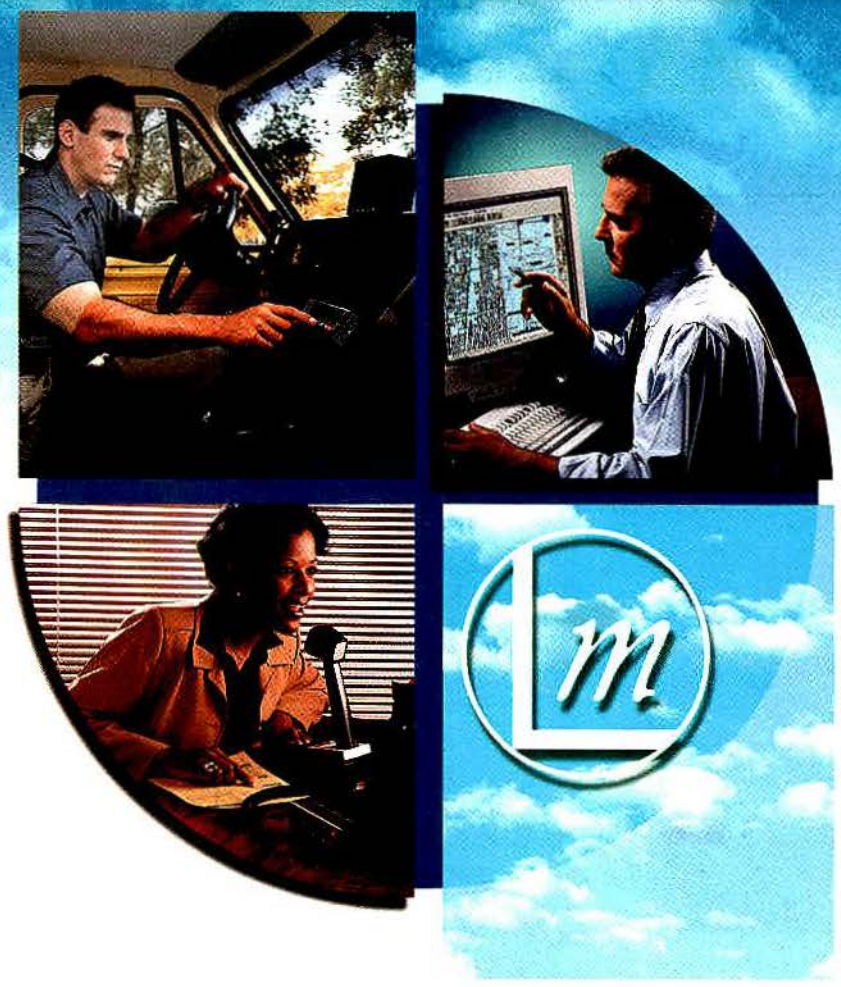
Cellxion **Booth 1652**
Existing products
One-stop source for communication network products and services; turnkey packaging construction services, equipment installation; shelters; cabinets and towers.
New products
Modular expandable cabinet—eight-bay cabinet that allows installation of 19" or 23" equipment racks.
Circle 225

Celwave **Booth 925**
Existing products
Maximizer series, Cellite series; 48522-N bi-directional amplifiers; 48610 microcell boosters; Penetrator series.
New products
Maximizer APL869012; Optimizer ALE869017.
Circle 226

Cerulean Technology **Booth 1415**
Existing products
Packetcluster Patrol, wireless information software; Packettrack, AVL and mapping system software.
Circle 227

CES Wireless Technologies **Booth 1834**
Existing products

Cellular Phones Eroding Away Your Profits?



Use of cell phones for fleet communications is expensive. VERY expensive! RoameR One offers a unique solution at far less cost. With a RoameR One LM 2-way radio system, users get superior performance and advanced digital features – all without the high variable costs associated with cellular.

Upgrade Your Customers to RoameR One Today!

- *Flat rate billing*
- *Unlimited usage*
- *No busy signals*
- *Built-in data capability*
- *Dispatch and private unit-to-unit calling*

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Write or call for details.

Excellent Dealer Opportunities

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Circle (38) on Fast Fact Card

Mobile display terminals; GPS automatic vehicle location; status terminal mapping and dispatch software; microphones; ANI modules; telephone interconnects; repeater makers.

New products

TRK-240 mobile display terminal; GPS-200 automatic vehicle location unit; Power-trak graphic mapping software; ARI-195E ANI/status display console; VAD-8 audio delay modules; RM-20 repeater maker.

Circle 228

Charge Guard **Booth 2028**

Existing products

ChargeGuard automatic on-and-off timer switch for two-way radios, cellular phones, mobile computers; Shopware software for the two-way communications industry.

Circle 229 See ad page 94

Cimarron Technologies **Booth 1820**

Existing products

Skymark II GPS-based AVL system; plug-in options such as status/text terminal, laptop PC interface for mapping and email, sensor inputs and relay outputs; GE-star ANI radio identification products; modules to fit every radio type, allows mandown, emergency, radio kill, open mic monitor and transmission identity.

New products

Skymark II GPS-based system with new interfaces for CDPD and cellular systems; five sensor inputs and five relay outputs for the vehicle; VehicleTracker 4.0 with user-defined alarm fences timers.

Circle 230



Circle (39) on Fast Fact Card

CommScope **Booth 741**

Existing products

3/8", 1/2", 7/8", 1 5/8" coaxial cable along with associated connectors, jumper assemblies and other mounting hardware, grounding hardware and accessories.

Circle 231 See ad page 46

Communications Data Services **Booth 2411**

Existing products

Professional engineering software; signal and contour propagation calculation and mapping software designed to run under Windows 95/NT, including three-second terrain, seamless topographic maps and land use/land cover enhanced algorithms. The tool provides system design and analysis capabilities for land mobile, SMR, public safety, cellular and PCS systems professionals.

New products

Enhancements to RFCAD version 2.

Circle 232 See classified ads

Computer Resources **Booth 2406**

Existing products

Thrukey computer systems for the two-way industry; products include sales and service management, mobile radio billing, pager billing and inventory, all associated accounting modules.

New products

Software version CRI-PRO 2000.

Circle 233 See classified ads

Comtelco Industries **Booth 2423**

Existing products

BSXL series omnidirectional base station antennas 40MHz–2.4GHz; BSS series omnidirectional base station antennas 220MHz–960MHz; mobile antennas 30MHz–2.4GHz.

New products

BSS series omnidirectional base station antennas 1.2GHz, 1.5GHz, 1.9GHz, 2.4GHz; directional yagis 22 series 1.5GHz, 1.9GHz, 2.4GHz.

Circle 234 See classified ads

Connect Systems **Booth 1800**

Existing products

LTR system controllers; repeater tone panels; interconnects; dial-up paging terminal; communications systems decoders.

New products

Connect Systems model 8300D.

Circle 235

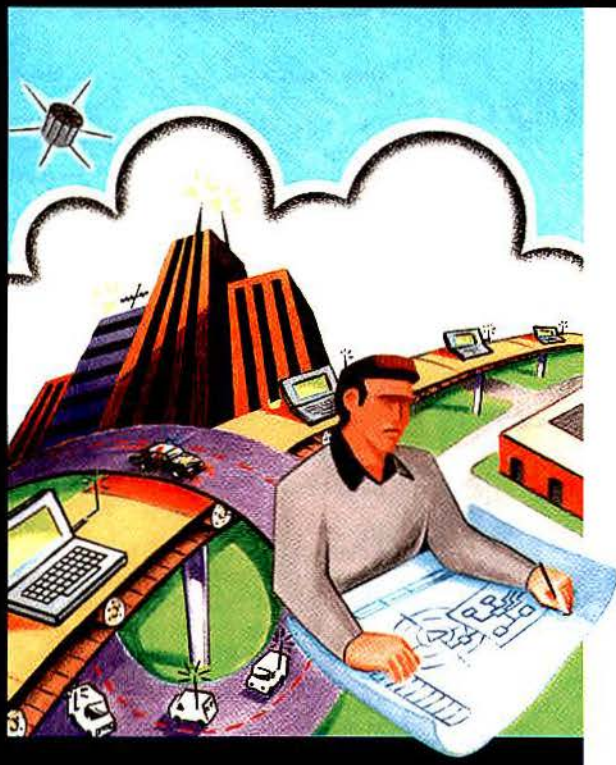
CPI Communications **Booth 1230**

Existing products

YOU NEED AN ANTENNA.

YOU NEED MAXRAD.

ENGINEERING • PROTOTYPING • MANUFACTURING



ANTENNAS BUILT TO YOUR SPECS

Our expert staff is equipped to engineer and manufacture custom antennas and accessories to your specifications. We utilize the latest simulation and modeling techniques to quickly prototype and develop your antenna products. We pride ourselves on getting the job done right the first time as an extension of your team.

Consider us your antenna experts.

- Low Band
- VHF
- UHF
- 800/900 MHz
- I.S.M. Bands
- Yagis
- Omni-Directional
- Mobile
- Portable



At MAXRAD, we always have available a full line of high-quality antennas capable of fitting a wide variety of RF applications. But when your project calls for a custom antenna, we excel at working closely with you to build the right product, on time, on budget and on target with the specifications you require. Big job or small, we will do what it takes to satisfy your antenna needs.

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STATE OF THE ART ANTENNAS

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MAXRAD
TWENTY YEARS
1978-1998

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Dc remotes; tone remotes; dc termination panels; tone termination panels; local extensions; multichannel remote systems.
Circle 236 See ad page 101

CTI **Booth 1916**
Existing products
Opti-page/voice mail; PR-150 (page repeater); Mitee-page Alpha; Pagemaster Phase II; Opti-TNPP (trunk-to-TNPP concentrator); TNPP-310 (trunk-to-TNPP concentrator); DID trunk manager.
New products
TTR-4128 (TAP-TNPP router).
Circle 237

Cushcraft **Booth 723**
Existing products
Fixed site, fixed subscriber, portable and mobile antennas for PCS, PCN, LMDS, MMDS and SMR applications, including wireless local loop; antennas suitable for RAD/RASP and microcellular configurations.
New products
SXE mobile antennas available in 800/900MHz; SX450 mobile antenna, 450MHz–470MHz, 5dB; FR450 omnidirectional antenna, 450MHz–470MHz, 3dBi; FRX450 omnidirectional antenna, 450MHz–470MHz, 5dBi.
Circle 238

Daniels Electronics **Booth 552**
Existing products
Low band VHF, UHF, 800MHz and 900MHz modular radio systems; digital multiplexers; exchange and subscriber equipment with applications for base stations, repeaters, transportable radios, rural telephone and ground-to-air systems.
New products
MT-3 lowband base station; MT-3 redundant radio system; MT-3 multiple receiver rack; low density digital multichannel radio system.
Circle 239 See ad page 84

Data Express **Booth 437**
Existing products
DE-2400G RF modem with GPS; DE-500 mobile status messenger; DE-2000 mobile data computer with GPS; fleet management 2000 AVL software.
New products
Dispatch Express software.
Circle 240

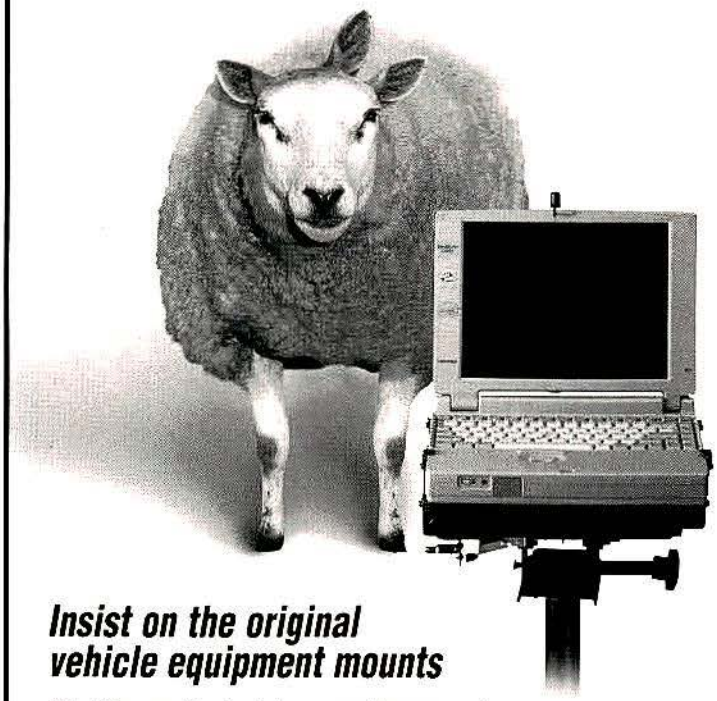
Datumtech **Booth 1757**
Existing products
Automatic vehicle location; wireless video surveillance; mobile data technology; heads-up display; alarm systems.
New products
DT4782 Videocam video surveillance system.
Circle 241

Davicom Technologies **Booth 331**
Existing products
VHF, UHF and 900MHz base station antennas; VHF, UHF, 800MHz and 900MHz cavity filters including multicouplers, duplexers, TX combiners and RX multicouplers; Mac system remote monitoring unit.
New products
Minimac remote monitoring unit; MACNET central management software version 2.0; 2.4GHz grid antenna.
Circle 242

David Clark **Booth 401**
Existing products
Headsets with push-to-talk adapter cords for mobile and portable radios; headsets voice-activated for portable radios; headsets intercom systems with two-way radio interface.
New products
Hardhat-attachable headset compatible with C6000 series adapters for portable and mobile radios; H6040/H6041 behind-the-head style headsets with new comfort and versatility features (30% reduction in clamping force, rotatable microphone and boom assembly for left or right positioning).
Circle 243 See ad page 31

DCI Digital Communications **Booth 2236**
Existing products

As it turns out, cloning doesn't always work...



Insist on the original vehicle equipment mounts

Why? Because Gamber-Johnson combines years of proficiency and insight to design the best mounting solutions for its customers.

Where copycat mounts rely on shortcuts to get by, *Gamber-Johnson offers a proven problem-solving approach.*

Unlike copycat mounts, *Gamber-Johnson mounts are part of a whole system of products* with modular assemblies that can be inexpensively upgraded as technology and vehicles change.

And where copycat mounts are by definition a generation behind, *Gamber-Johnson assures you state-of-the-art design and construction.*

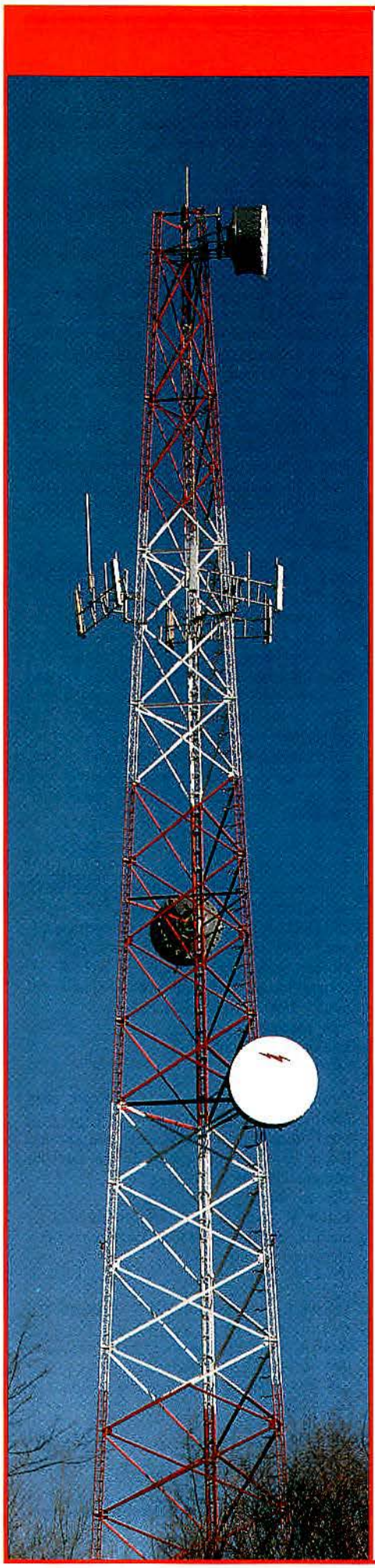
For all your mobile equipment... for any vehicle...look to the leader in vehicle mounts—Gamber-Johnson. *Often copied, never duplicated.*

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Service & Solutions in Mobile Mounting Hardware

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Circle (41) on Fast Fact Card



No matter
how high,
how far,
how fast,
how clear,
how icy,
how windy,
how wet
or
how many.

PiRod's solutions are SOLID.



PiRod can manage your unique tower needs with custom-designed solid rod, free-standing or guyed towers built to your specs and erected where you need them now. Our towers are solid—engineered to handle your most critical problems—and customers tell us that our turnkey design and erection services are pretty solid too. Like our record of providing tower solutions since 1952. So when you need a solid partner for your communication needs, call PiRod. When it comes to towers, there's just nothing hollow here.

Solid Rod, Solid Service, Solid Value

For a free guide to tower selection and a fast, courteous response to your request for a quotation, contact:

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Solid Rod, Solid Service, Solid Value

PiRod, Inc.
P.O. Box 128
Plymouth, Indiana 46563-0128
(219) 936-4221
Fax (219) 936-6796
www.pirod.com

Circle (42) on Fast Fact Card



Bandpass filters; tower-top amplifiers; duplexers; tower-top duplexers.
Circle 244

DDB Unlimited/ITD **Booth 218**
Existing products
Indoor and outdoor enclosures; surge suppressors.
Circle 245

Delta Electronics Mfg. **Booth 1422**
Existing products
RF connectors: 7/16" or DIN, BNC, Type Ns, SMA, SMB, TNC, SMC, between-series adapters, type C and low-IMD interconnect products.
New products
BNC, type N, TNC with reduced-size flanges; one-step type N, SMA and BNC for semi-rigid cables; pressmount mounting connectors.
Circle 246

Digital Dispatch Systems **Booth 651**
Existing products
Mobile data communications-based automated dispatch systems and vehicle location systems.
New products
GDT 800 graphical display terminal.
Circle 247

Direct Power and Water **Booth 753**
Existing products
Integrated solar power systems; DP&W enclosures and solar electric module mounting structures; Solec International solar modules; Trace Engineering inverters and charge controllers; Uni-box enclosures.
Circle 248

Dispatch Products **Booth 2334**
Existing products
Full furniture systems integration products including modular steel, universal open plan and custom-designed furniture and case goods.
Circle 249

DTC Communications **Booth 950**
Existing products
SK security kits; tactical equipment; headsets.
New products
SK-2 inductive loop security kit consists of a mini-microphone, palm-held PTT switch and inductive neck loop, designed for use with a DTC in-the-ear wireless receiver. RM3 receiver/mic security kit. A combination receiver/microphone and palm-held PTT switch, allows the user to transmit and receiver with the same ear-worn receiver/mini boom mic.
Circle 250

DX Radio Systems Booth 816
Existing products
Millennium repeaters and base stations (RTF series), trunking systems (DXL-LTR series and DXM-MPT1327 series); paging transmitters; 4000 non-simulcast series and 6000 simulcast series; radio telephone links RTD-series; model 835 AM ground-to-air and model 9800 ground-to-air radios.
New products
Exicom digital radio link.
Circle 251 See ad page 70

Eaton/Cutler-Hammer Booth 1934
Existing products
Fleet Advisor logistics management system; Eaton on-board computer; Eaton satellite communications modules.
New products
Eaton SCM 5500 satellite communications module; Eaton SCM 5500L satellite communications module.
Circle 252 See ad page 52

Electro-Comm Distributing **Booth 113**
Existing products
Availability of thousands of items from more than 80 product manufacturers; provides local one-stop shopping for wireless accessories.
Circle 253

EPCOM Booth 539
Existing products



Circle (43) on Fast Fact Card



THE NEW IFR COM-120B, AHEAD OF THE CURVE

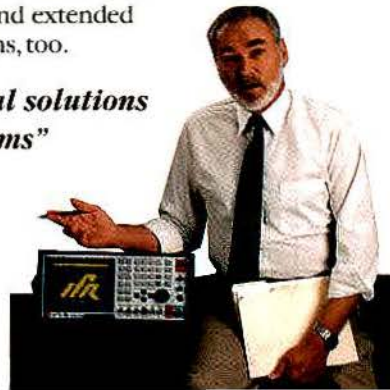
Predicting tomorrow's technology is a difficult road to travel. But with the new generation COM-120B, you don't need road signs to predict the twists and turns of wireless communications testing. With its field proven performance and incorporating over a dozen new innovations, the COM-120B easily negotiates the course of wireless testing.

Straight away, you'll experience the blazing speed of the upgraded microprocessor. The new graphics system provides the flexibility to display customized test results. And for more demanding test and configuration requirements, the COM-120B has an independent functioning tracking generator, that allows simultaneous sweeps of two sets of RF frequencies.

Plus, PCMCIA port enhancements give you additional flexibility to configure user defined test parameters and program files. This configurable data port turns the COM-120B into a remote controlled input/output source, allowing you to initiate tests by simply plugging into a modem. And with its unique internal/external file storage and retrieval system, the COM-120B offers you unrivaled data storage, test configuration and analysis power.

Of course, the new generation COM-120B is backed by the kind of service and support that you expect from a global leader in test instrumentation. For solutions that keep pace when communication technologies change, call 1-800-835-2352. Ask about our lease/rental and extended warranty programs, too.

"I found real solutions at IFR Systems"



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RF Division

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316-522-4981 • 1-800-835-2352 • FAX 316-522-1360
Circle (44) on Fast Fact Card

Visit IFR Systems on-line at http://www.ifrsys.com

For information on career opportunities, contact IFR Systems Human Resources Department.

Visit us at IWCE Booth 2100.

Two-way radio communication equipment and a complete line of accessories; major brand only for export: Kenwood; also Icom, Uniden, Vertex and Maxon.
Circle 254 See classified ads

Ericsson **Booth 600**
Existing products
Terminals and mobiles.
New products
Dealer programs.
Circle 255

E.S.I. Cases and Cellular Accessories **Booth 550**
Existing products
ESI cases and cellular accessories carry a wide variety of paging and cellular products: from Plus cases to Ultra Express cases. Screws, lens, screw drivers and buttons. In cellular: an array of leather cases, quick chargers, power cords.
New products
Teletac 250 phone housing, gizmo housing, worldline pager housing and radio pager housing.
Circle 256

Eupen Cable USA **Booth 1931**
Existing products
EC3 corrugated copper cables and connectors with lowest loss and toughest construction; 12-year warranty.
New products
O-ring seal connectors; one-piece 1/2" superflex connectors; new Web site: *www.eupen.com*.
Circle 257 See ad page 20

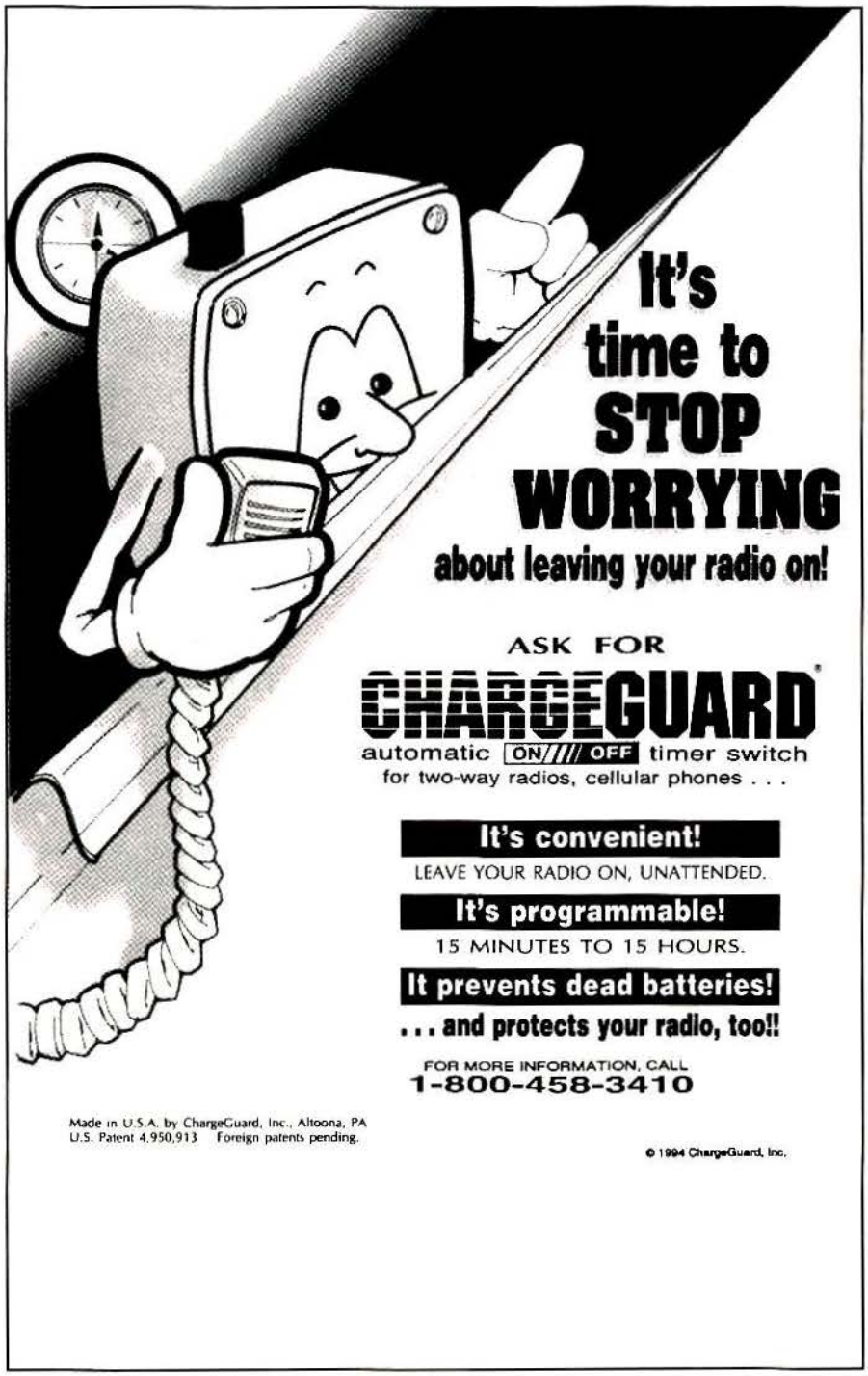
Eventide **Booth 1404**
Existing products
VR320 eight–32-channel digital voice logging recorder; VR204 four-channel digital voice logging recorder; PC remote control for use with Eventide digital voice logging recorders; ECW-40 satellite chronometer.
New products
Model DIR-911 digital instant recall recorder.
Circle 258

Fanon Courier **Booth 2001**
Existing products
Courier: Procom M-54 and MU-54 four-channel capacity, crystal-controlled VHF and UHF portable transceivers; Procom M510 and MU510 5W, 10-channel synthesized programmable portable VHF and UHF transceivers. Fanon: megaphones, P.A. amplifiers; paging and talkback speakers; paging systems.
New products
Courier: Procom M520 5W, 20-channel programmable portable VHF transceiver; Procom MU520 5W, 20-channel programmable portable VHF transceiver; FRS Family Radio Service UHF portable transceiver.
Circle 259 See classified ads

Fibrebond Resources **Booth 100**
Existing products
GFRC and solid concrete communication shelters; guyed and self-supporting steel towers; professional equipment installation services.
Circle 260

Fiplex Communications **Booth 1238**
Existing products
Mobile duplexers; base station duplexers; transmitter combiners; receiver multicouplers; RF isolators; filters and preselectors; tower-top systems; power dividers.
New products
Dual bandpass duplexers for GSM, DCS and PCS applications; "DDBP series;" high-power, compact size duplexers for mobile applications "DHV series;" dual bandpass duplexers for wireless loop applications "DDBP series."
Circle 261

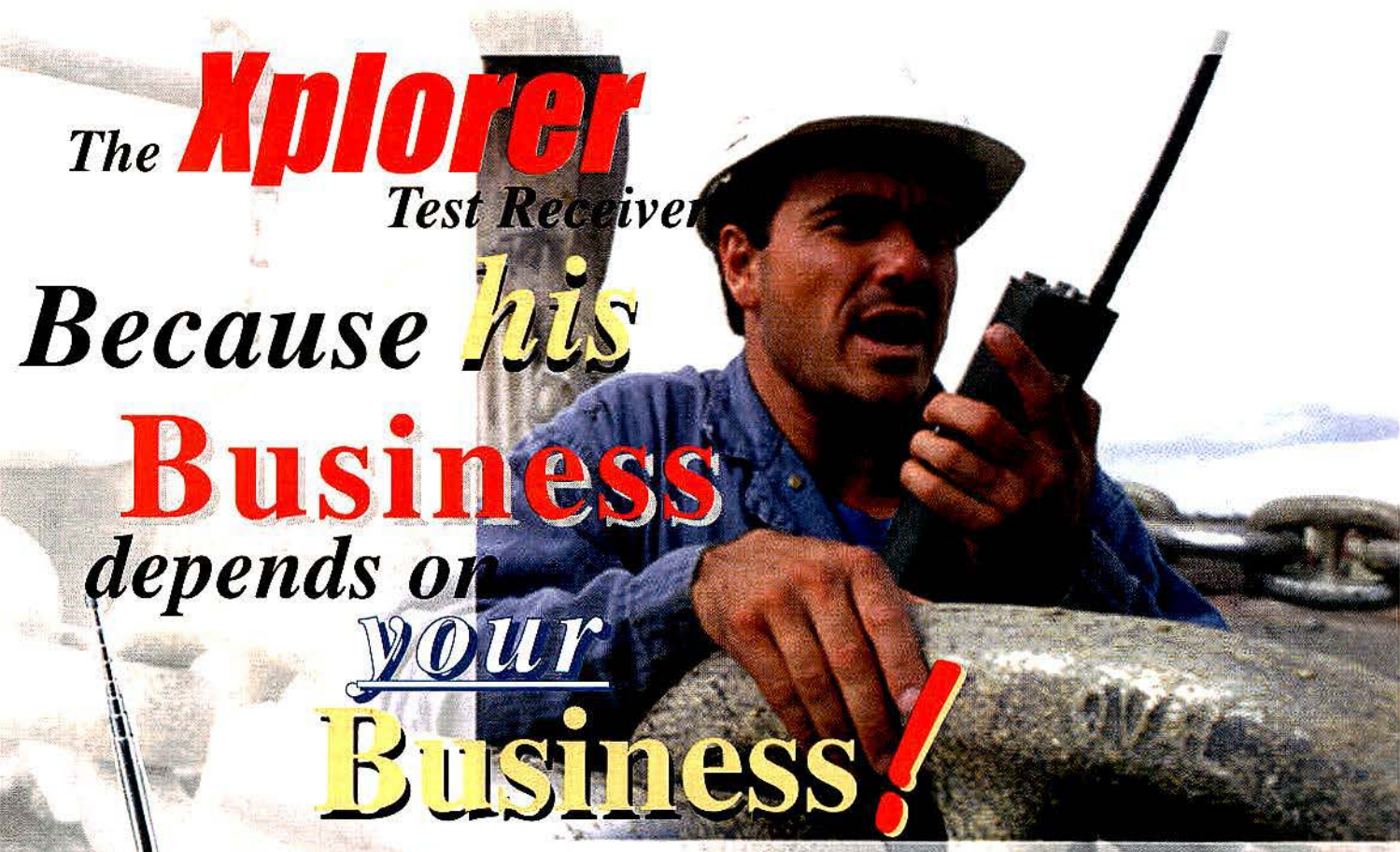
Flash Technology **Booth 1935**
Existing products
Tower lights FTB310, FTB312.
New products
Eagle alarm management system; Flash



Circle (45) on Fast Fact Card

The Xplorer Test Receiver

Because his Business depends on your Business!



NEW



For Commercial and Mobile Radio testing, the Optoelectronics Xplorer stands alone. Let the Xplorer perform all your quick radio checks, instantly determining the radio's frequency, CTCSS, DCS, DTMF, deviation or signal strength. The Xplorer automatically locks on to any nearfield signal from 30MHz-2GHz in less than a second.

There is no setup necessary-Whether you're in the field or in the shop, the Xplorer is the portable, compact and economical solution for any two-way communications business.

FEATURES:

- Nearfield receiver, sweeps 30MHz-2GHz in <1 second
- Decodes CTCSS, DCS, and DTMF. Manually record tones into memory
- Lockout up to 1000 frequencies
- Store 500 frequencies in memory with time & date stamp, as well as number of hits per frequency
- NMEA-0183 GPS interface for recording Latitude & Longitude coordinates (GPS Required)
- Numerical Deviation & Signal Strength bargraph
- VFO mode for tuning to specific frequencies
- PC interface for downloading data from memory
- FM demodulation / Built-in speaker
- Auto or manual frequency hold
- Maximum nearfield reception / Up to 1/4 mile away

Communications Decoding

The Xplorer's 2 line LCD can selectively switch between CTCSS, DCS, and DTMF displays.



CTCSS Display



DCS Display



DTMF Display

Specifications

Frequency Range: 30MHz -2GHz
Modulation: FM, Deviation <100KHz
Freq. Response: 50 - 3000Hz
Auto Sweep Time: <1Second
Input: 50Ohm, -59dBm @100MHz
-25dBm @1GHz
Display: 2 line LCD w/ EL backlight
Power: Internal NiCad Pack, 7.2V 850mA

Decoding Capabilities

CTCSS Tones: 52
DCS Codes: 106
DTMF characters: 16:1234567890*#ABCD

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Prices & Specifications subject to change without notice or obligation

Circle (26) on Fast Fact Card

See us at IWCE Booth 125.

Technology monitoring services.
Circle 262

Fryer's Site Guide **Booth 817**
Existing products
Fryer's Site Guide Directory of Tower Sites, coordinates, AGL's AMSL's, contact names and phone numbers featured; data services provides electronic data and more.
New products
Tower Owner's Buyer's Guide; tower registration services.
Circle 263

Futurecom Systems Group **Booth 117**
Existing products
Sitexcom on-channel and translating repeater systems; Mobexcom crossband and in-band mobile repeaters; Chanexcom LA3B multiband line amplifiers.
New products



Circle (27) on Fast Fact Card

FTR single-channel frequency translating repeater.
Circle 264

Gabriel Electronics **Booth 2232**
Existing products
SS series of spread-spectrum antennas, ranging from parabolic grids to solid parabolic antenna models; SSFP-23 flat panel antenna for operation in the 2.3GHZ–2.5GHz ISM/spread spectrum band; other wireless antenna products.
New products
Sector Horn antennas for point-to-multipoint applications—the S90V-380 and S45-380 Sector Horn antennas operate in the 38GHZ–40GHz band.
Circle 265

Gamber-Johnson Booth 834
Existing products
Notepad; Quad-motion TSS; DS series bases; slide mounts; MCS series systems; Radio Rock packages.
New products
Trunk organizer; seat organizer; quick-release post; switch control power center.
Circle 266 See ad page40

Hark Systems Booth 1022
Existing products
SMR/DID interface equipment allowing no-answer transfer when a call goes unanswered, as well as providing an interconnect networking hub for roaming; TSM 2000 tower site monitoring equipment with card access.
New products
One-number switch, the Mega, with new features such as debit calling, TNPP connection to a paging terminal for voice mail alerting, expanded voice mail features and alpha transcription.
Circle 267 See ad page 18

Hughey & Phillips **Booth 1051**
Existing products
Aircraft warning obstruction lights; all products are ETL certified and approved by the FAA, Transport Canada and I.C.A.O. Product classifications are high-intensity strobe lights, medium intensity strobe lights, incandescent lighted red beacons, neon steady burning warning lights and controllers for all systems.
New products
24V dc FG3000 dual strobe beacon, which provides red light for nighttime and white light for daytime.
Circle 268

Hutton Communications Booth 1208, 1319, 1321
Existing products
Distributor of products from more than 100 wireless communications equipment manufacturers to wireless carriers, dealers and self-maintained end users of communications systems; distributor of wireless telephone accessories, test and shop equipment, radio communications products, power systems

If you're designing wireless communications devices, we're the antenna and battery pack specialist you need.



We developed this connector for spread spectrum applications in compliance with FCC Part 15.



We designed these 2.4GHz antennas for wireless LAN applications.

An impossible deadline. A shrinking budget. And the antenna and battery pack are critical to the success of your design. You need Centurion International right *now*.



Every battery pack we design and manufacture meets or exceeds all electrical, mechanical and functional specifications.

- ***RF engineering experience from 3MHz to 94GHz***
- ***Custom battery pack assemblies incorporating nickel cadmium, lithium ion, nickel metal hydride or alkaline cells***
- ***Full range of frequencies from 27MHz to 6GHz***

Our customers–many of the leading wireless manufacturers in the world–have grown to trust our ability to design, engineer and manufacture antennas and battery packs to tight tolerances. In high volume. On time. And on budget.

Let's talk. Tell us what antenna and battery pack you need right now (or more likely, yesterday).

Call us today for a
FREE Custom Antenna And Battery Pack Design Specifications Kit.

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Get it today!
Download your free design software at www.centurion.com!

This PCMCIA application demanded the performance of a 17 cm antenna in a 7 cm package design.



On **time** *... at the right* **price** *... and it'll* **work.**®

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Circle (28) on Fast Fact Card

Lucent Digital Cellular Telephone 6720
Centurion International has developed antennas for many Lucent Technologies Inc. wireless terminals which meet Bell Labs specifications.

TWENTY YEARS 1978 20 1998 OF INNOVATION

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equipment and infrastructure products.
Circle 269 See ad page 19

ICOM America Booth 422
Existing products
Land mobile commercial band radios; receivers and avionic radios.
New products
IC-F320/F420 simple low-priced mobile; IC-F3S/F4S simple portable; IC-F35/F45 export portable.
Circle 270 See ad page 53

ICT Booth 1059
Existing products
Ac-to-dc switching power supplies (4A–80A models); base station wraparound covers; dc-to-dc converters; noise filters and surge protectors.
Circle 271 See ad page 67

IDA Booth 735 & 3001
Existing products
Trakit AVL system; RLC-LTI trunking controller; 24-66 remote controls; Net-link multipath networking; CVT LTR conversion kits; V-series mics.
New products
Trakit-USA; Trakit-VT vehicle terminal; CVT-P LTR conversion for hand-helds.
Circle 272 See ad page 78

IFR Systems Booth 2100
Existing products
Com-120B communications service monitor; 1200 Super S communications service monitor; FM; AM-1600S communications service monitor; GPS-101 satellite simulator.
New products
"AN" series spectrum analyzers.
Circle 273 See ad page 43 & classified ads

Industrial Telecommunications Association **Booth 635**
Trade association representing private wireless industry.
Circle 274

Instrument Associates Division/ Gai-Tronics Booth 1926
Existing products
ITR2000 tone remote deskset; ITA2000 tone remote adapter; ILD2000 local deskset; ITI6000 telephone interconnect; IRC3000 repeater controller.
New products
ITR2300 16-frequency tone remote deskset; IPE2500 paging encoder/desktop controller; ITR1000 tone remote deskset; ILD1000 local deskset; IDR1000 dc remote deskset; IDA1000 dc remote adapter.
Ci 275 See ad page 66

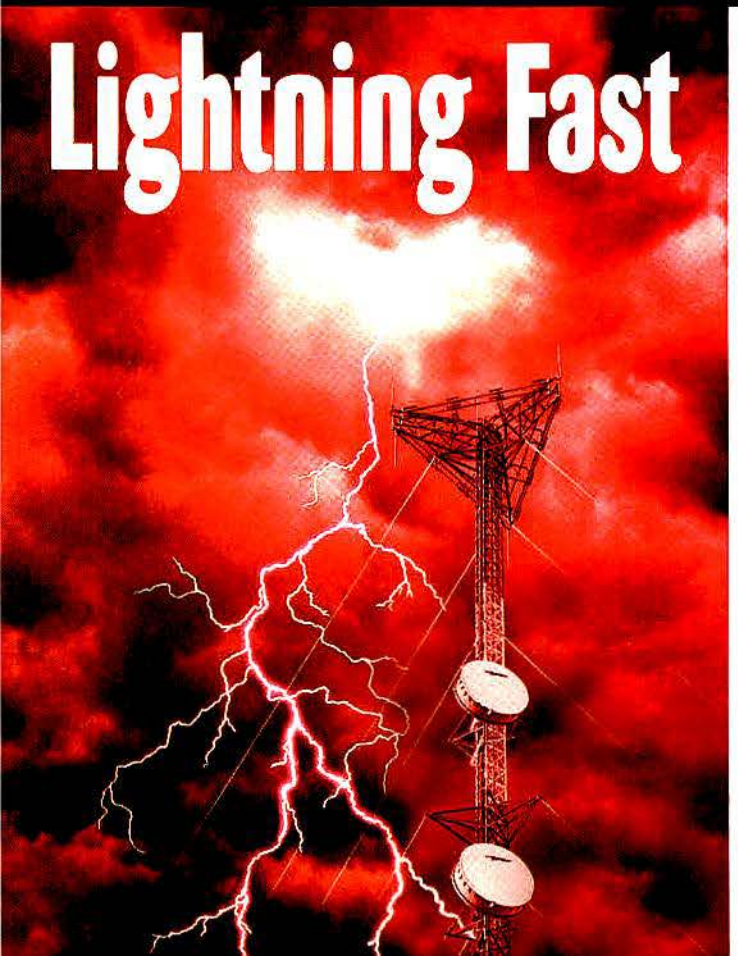
Intellisoft **Booth 2422**
Existing products
BeepPlus management software 5.2; BPMS IVR teller; BPMS terminal interfaces; BPMS agent access and IVR agent access.
New products
IVR Teller.
Circle 276

International Crystal Mfg. **Booth 2300**
Existing products
Crystals; oscillators and filters. Manufacturing is in Oklahoma City and offers quick-turn capability.
Circle 277

International Mobile Telecommunications Association Booth 714
Existing products
IMTA: *The Worldwide Directory of Commercial Trunked Radio Dealers; The Global Digest.*
Circle 278 See ad page 76

Intraplex **Booth 2131**
Existing products
Intralink 6000 series ISDN multiplexers; TDM-160/260 T1/E1 multiplexers.
New products
DCS-9560 cross-connect access system.
Circle 279

Pretensioned grounding strap makes lightning protection a snap



Protection



Protect your system with the new, fast-to-install, reliable SureGround™ grounding kit from Andrew.

The one-piece strap snaps tightly around the cable's outer conductor and secures with a built-in locking clip. Exact contact pressure every time. No tools. No lost hardware. Done in no time.

SureGround kits save money and last years longer. Kits are fully tested to withstand the most severe lightning strikes. The IEC 1024-1-compliant solid copper ground lead reduces dc resistance and lowers impedance so lightning chooses SureGround and not your cable.

With SureGround, you can weather any storm with confidence.

For more details, call Andrew or your local Andrew Distributor today.

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Circle (29) on Fast Fact Card

land mobile

Now available with SmarTrunk II™



Icom Leads the Way

PRIVACY

Transcrypt scrambling is now available on most Icom F-series radio models.

TRANSCRYPT INTERNATIONAL

Transcrypt has modified their renowned scramblers specifically for Icom. The result: great audio in a highly secure conversation.



12.5/25 kHz CHANNEL SPACING

Icom's IC-F3VHF/IC-F4VHF F-series radios (above, in hand) support either 12.5 or 25 kHz FM channel spacing.

Most of Icom's F-series radios are multi-mode radios: multi-mode radios support 12.5 AND 25 kHz widths in the same radio. Program individual channels to operate either 12.5 or 25 kHz. It's like getting two radios for the price of one!



• Advanced PC Programming

Icom F-series radios can quickly be configured for simple or advanced use. Easily PC program a huge variety of settings, even by individual channel.

• The Latest Features & Technology

The right tool for the right job! Intrinsically safe radios meeting Mil Spec C, D & E ratings. 2-tone/5-tone capability radios with 9600 baud data ready operation. Simple, secure 2-way radios with a minimum of controls. Your dealer can configure the correct Icom radio for nearly any situation.

• Rugged, Die-Cast Construction

All Icom F-series radios feature a one-piece, die cast aluminum chassis for durability, signal clarity & efficient heat dissipation. Polycarbonate cases, too.

• Talented Service & Support Staff

Full time technical support by phone.

• Great Value!

Icom is the Leader in Price Performance

Compare! Icom offers the best in performance and features… for less.

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Circle (47) on Fast Fact Card

Wireless devices; UHF trunking portable; FRS radios.
Circle 299

Maxrad — Booth 432

Existing products

Chrome coil mobile antennas; aluminum yagi antennas; Max base mobile antennas; gold anodized yagi antennas; chrome nut mobile antennas; fiberglass base station antennas; Max duck portable antennas; GPS antennas; Mini Mag series antennas; various mobile mounts, cables, connectors.

New products

MFB24004, MFB24006, MFB24008 2.4GHz omnidirectional base station antennas; MYP24013, MYP24021 2.4GHz yagi antennas; MPR 2.4GHz parabolic reflector antennas; MHW2400, MQW2400 2.4GHz Max duck portable antennas; MWV1322, MWH4505 wideband chrome coil antennas; MAX8155 5dB-gain cellular/SMR antenna.

Circle 300 — See ad page 39

Mentor Engineering — **Booth 233**

Existing products

Mobile Data Computer offers two-way messaging, internal GPS, eight-line transflective graphics-capable display, PCMCIA slot, multiple I/O and internal smart card/credit card reader in one compact unit, compatible with a wide variety of communication networks and integrates to dispatch software through Mentor's XGate software module.
Circle 301

Merry Electronics USA — **Booth 649**

Existing products

CB microphones; land mobile microphone; multimedia mics; vocal mics; DTMF mics; headsets; hands-free kits; dynamic/mylar speakers; external speakers; speaker microphones; transducers for cellular and cordless phones (with HAC).

New products

HDC712; HDC716; DMC568; DMC558; DSH series; CTR series.
Circle 302

Metric Systems
Booth 2328

Existing products

Mavric Explorer (MAV-EXPLR) for fixed and specialized mobile, integrated wireless data acquisition, control and AVL/GPS; Mavric 5000nx (MAV5000nx) wide-area wireless data hub and relay router; Pathfinder Explorer 9600 (PATH-9600) UHF and VHF wireless synthesized data transceiver.

New products

Mavric 2000nx, a next-generation wireless router and controller designed for building high-speed point-to-point and multipoint fault-tolerant wireless data networks. The controller includes standard interfaces such as 10BaseT ethernet, high-speed synchronous and RS-232 asynchronous; suitable for wide-area TCP/IP networks for SCADA, industrial automation and CAD dispatch.
Circle 303

Micropath — Booth 655

Existing products

VHF/UHF/microwave software for communications engineering applications.

New products

Micropath 2001 VHF/UHF/microwave path analysis and path profile program.

Circle 304 — See classified ads

Midian Electronics — **Booth 629**

Existing products

Rolling code scramblers; multiformat ANI remote control; encoder/decoders; multicode inversion scramblers.
Circle 305

Experience the Alexander Advantage...



Alexander has been manufacturing batteries for the wireless industry for more than 30 years. We are dedicated to excellence, making the Alexander name the choice for quality and reliability.

We have world-class design and production facilities for both batteries and chargers. This gives you a single source for portable power and battery charging/conditioning for all your communications needs.

Superior quality and reliability result in longer battery life and lower cost per use.

With plants in the U.S. and England, Alexander serves a worldwide market for the wireless communications, medical, security, military, cellular, video and OEM applications.

Alexander —

- ISO 9001 international quality certification
- Features a wide selection of cells from leading manufacturers, with choices in cell chemistry based on performance and price requirements
- Choice of chargers and conditioners which are precision-matched to the cells used and the customer's application
- Nationwide customer service hotline and product selection assistance
- OEM design and manufacturing services
- More than 30 patents covering a broad range of battery and battery charging technologies
- FDA registered facility

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Circle (48) on Fast Fact Card

Midland USA **Booth 1000**

Existing products

70-0000 series Bantan, Syn-tech XTR, Syn-Tech II mobile radios, accessories; 70-0000 series Syn-tech XTR desktop base stations; 70-0000 Base-tech base stations, repeaters, options; 18-000 series mobile antennas; 70-000 portable radios (series); 75-3000 series 220MHz linear modulation mobiles, portables, repeaters.

New products

70-0000 Mid-tier mobiles; 75-4000 series 220MHz linear modulation mobiles, portables; VHF linear modulation systems, mobiles; 70-0000 LTR mobiles, portables.

Circle 306 See ad page 7

Mobile Radio Technology **Booth 1300**

Existing products

Mobile Radio Technology is recognized as the leading source of technology-focused industry guidance. Readers include mobile radio dealers and service shops, large-volume end-users at public safety, government, transportation, business and industrial agencies, as well as paging and SMR service providers, and manufacturers and their reps and distributors. The editorial addresses the latest in equipment and applications, business developments, legal and regulatory matters. Visit our booth to pick up a copy, sign up for your free subscription, or bring by your oldest copy of *MRT* for the contest.

Circle 307 See ad page 85

Mounting Solutions **Booth 559**

Existing products

Laptop mounts, vehicle mounts for mobile computer applications; tilt swivels; posts and platforms; all mounting hardware for mobile computing.

New products

Multipositioning mount; swing arm with post mount; Pentax printer with roll paper holder.

Circle 308

Multiplier Industries **Booth 938**

Existing products

Rechargeable two-way and cellular batteries; current battery models include Motorola, Kenwood, Ericsson, Qualcomm, Midland, Maxon; intrinsically safe models and a wide variety of batteries for international radios.

New products

Replacement batteries for the Motorola Iden phones; models M8099, M8100 and M8101; Kenwood KNB-15, KNB-17; Philips PRP73; Boshe FUG-10; Motorola Radius P1225.

Circle 309

MX-Com **Booth 2009**

Existing products

Wireless modem ICs; wireline modem ICs; telephony; CVSD codecs; audio processor ICs; sub-audio tone signaling and detection ICs; voice security ICs; digitally controlled amplifier ICs; cellular ICs.

New products

MX980 8 PSK and p/4 DQPSK (digital radio baseband processor); CMX624 and CMX 644; BELL202, BELL212A, V.22 and V.23; modem ICs; MX839 digitally controlled analog I/O processor; CMX589A 4kbps to 80kbps low voltage GMSK modem IC.

Circle 310

NCG/Comet Antenna **Booth 1426**

Existing products

GP-9NC dual-band base/repeater antenna; VHF-UHF, dual-band mobile antennas; VHF-UHF, triband mobile antennas; VHF-UHF+ cellular; PCS antennas; bad-splitters VHF-UHF; base antennas VHF-UHF; base antennas for 900 to 930MHz; base antennas 2,400MHz to 2,460MHz.

New products

Power meters, VSWR meters; NCG 2050, NCG 3000, CM-720, CM-930 and CM-120; battery packs; Power Pocket 12VdcAh; dc power supplies; RP-150 variable 13.8Vdc variable amperage 2A–20A, RP-300 dc power supply, 13.8 Vdc variable amp 2A–30A.

Circle 311



Circle (49) on Fast Fact Card

When the entire industry told us to take a flying leap...



Visit us at IWCE 98' Booth #1500



Innovative technology that revolutionized the 450 MHz bandwidth.

We did! To wide open spaces.

When Uniden announced that we had reinvented the 450 MHz bandwidth, people thought we had finally gone off the deep end. But thanks to innovative thinking, Uniden found a way to make a forgotten bandwidth the wave of the future.

We began by adapting our LTR® Trunking and ESAS® Technology to the 450 MHz bandwidth. And now, we've introduced a full line of powerful, easy-to-use base stations, mobile and portable units. The result: 450 MHz is now an attractive alternative that your customers have been looking for. Which is making dealers everywhere jump for joy. For more information on our powerful line of quality products, call 1-800-762-1918 today!

visit our website @ www.prc.uniden.com

POWERED by Uniden ESAS

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Circle (50) on Fast Fact Card

Nearson **Booth 1155**
Existing products
RF connectors; cable assemblies; GPS, portable and cellular phone antennas.
Circle 312

Newmar Booth 2004
Existing products
Phase three battery chargers, integrated power system (I.P.S.); Power-pac; power rack systems; heavy duty power supplies; dc-to-dc converters.
New products
Phase three battery chargers.
Circle 313 See ad page 99

Nida Communications **Booth 2511**
Existing products
Communication consoles; repeater controllers; linear modulation radios.
New products
RC-200 repeater controller; shoulder pack transportable radio; Pyramid SVR-200 interfaced to Midland/Roamer mobile radio; AMSL satellite telephone in Nida transportable case.
Circle 314

Northern Technologies **Booth 343**
Existing products
Power protection cabinet (PPC); DMK series ac surge suppression; QWS series RF surge suppression.
New products
ACR-AB 19" rackmountable surge suppressor.
Circle 315

Northpoint Communications **Booth 1340**
Existing products
Lopro low-profile mobile antennas.
Circle 316

NSI Communications Booth 954
Existing products
Hand-held radios; GP-300; GP-68; HT-1000; mobile radios GM-300; SM-50; SM-120; accessories; power supplies; antennas; products covering VHF (136MHz–174MHz); UHF (403MHz–520MHz) and 800MHz.
Circle 317 See classified ads

Nutel Electronics **Booth 2005**
Existing products
Model 8000 point-to-point microwave radio (790MHz–2,500MHz); model 9500 frequency division multiplex (voice and data); model NT23, 23GHz microwave radio (10Mbps ethernet and 4tile).
New products
NT2400SS T1/E1 spread spectrum radio at 2.4GHz; NT900D 790MHz–960MHz digital radio.
Circle 318

Optoelectronics Booth 125
Existing products
Frequency counters; frequency recorders; test receivers; tone decoders; pre-selector; bench counters; DTMF decoder.
New products
Super Scout frequency recorder; Xplorer test receiver; DC442 Plus tone decoder; APS 105 pre-selector; Micro DTMF decoder; Micro frequency counter; Micro RF detector.
Circle 319 See ad pages IFC & 45

Orbacom Systems Booth 1820
Existing products
TDM series communications consoles; CAD and cabinetry.
Circle 320 See ad page 51

Otto Communications Booth 1429
Existing products
Two-way portable radio accessories including remote speaker microphones, noise attenuating headsets, lightweight headsets, low-profile earphone kits and replacement accessories.
New products
Single- and dual-speaker lightweight headsets; speaker microphone compatible with HT1000 radio.
Circle 321 See ad page 18

Pagetek **Booth 2419**
Existing products

Here's a Family that Keeps its Secrets

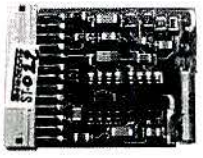
Introducing Selectone's Full Line of Voice Encryption Products

Today more than ever, the world of two-way communications needs the advantage of secure voice. The Selectone family of voice encryption products offers you **a clear choice at affordable prices.**

From the low-end inversion scramblers, the **ST-22** and **ST-20B**; to our mid-range scramblers, the **ST-25B** with digital rolling code security; to the state-of-the-art **Advantage-Plus** encryption series with time domain scrambling and digital signal processing, Selectone will provide the right product match for your specific security requirements. ***No hassles. No overselling. No kidding!***

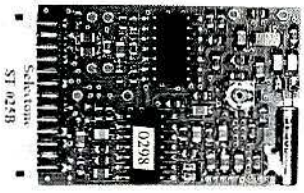
We're confident that our product line is exactly what you're looking for, and we'll provide you with a personalized quote to prove it. Simply give us a call, send us a fax or write to us with your requirements, and **we'll provide you with a customized quote at no cost.** It's simple. It's free. And best of all, it introduces you to the finest family of encryption products in the world. You have our name on it.

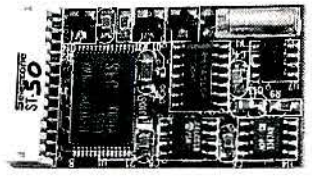
See us at IWCE, Booth 935.



Low-end inversion scramblers. ST-22, ST-20B

Mid-range scramblers. ST-25B





State-of-the-Art Advantage-Plus series. ST-50, ST-51, ST-52

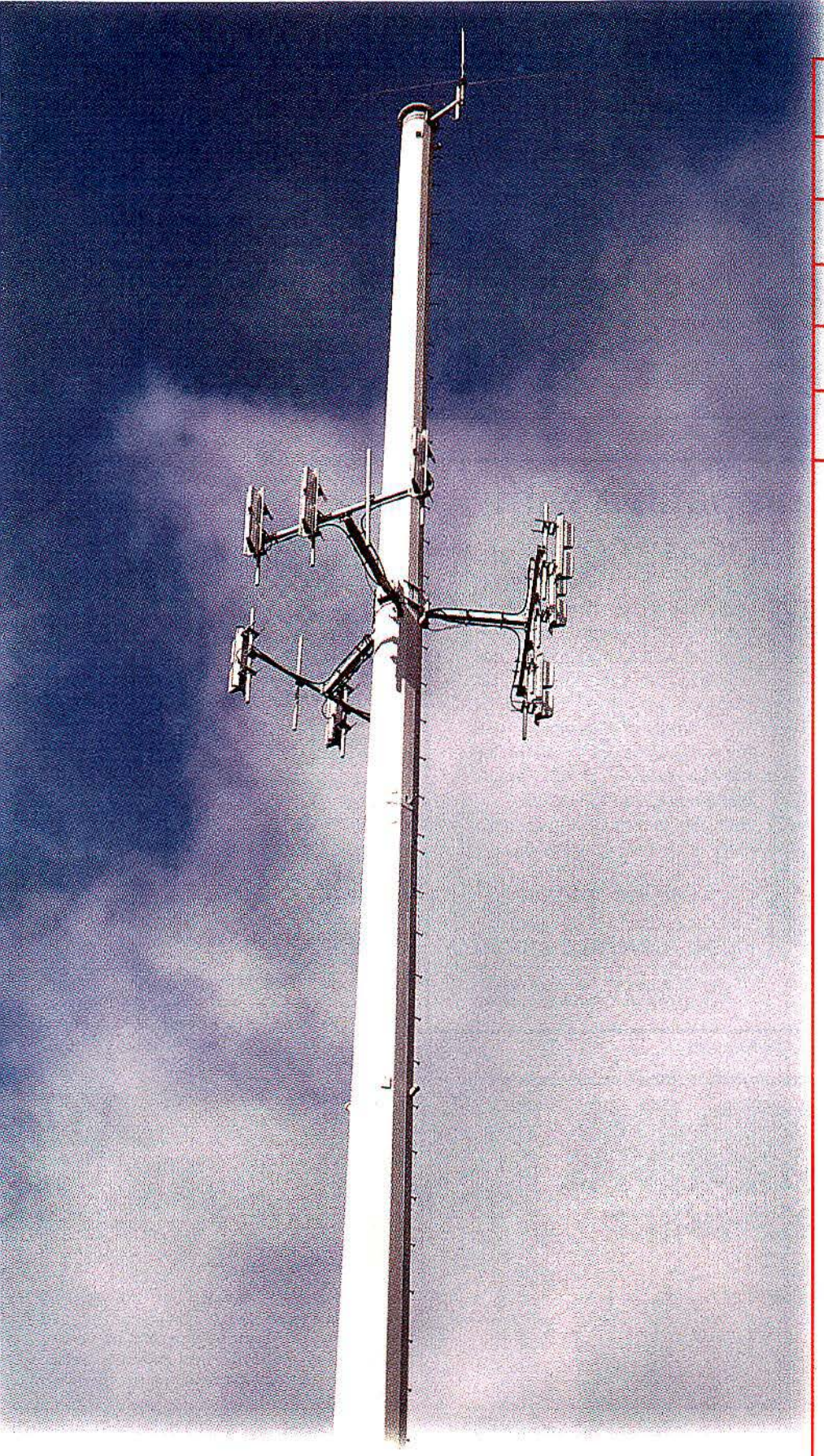
CUSTOM QUOTES AVAILABLE

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Selectone

Selectone, Inc. • 3501 Breakwater Ave. • Hayward, CA 94545 USA
Phone: 510-781-0376 • Fax: 510-781-5454 • Internet: www.selectone.com

Circle (51) on Fast Fact Card



Narda's tower top antenna amplifiers expand cell site coverage and heighten customer satisfaction.

It's not easy being a cell site in many areas. They can be challenged by remote locations, obstructions and low mobile phone output power. However, while there are many problems, there's one proven solution. Narda's tower top amplifier systems.

These unique systems have been designed for use on RX antennas or duplexed RX/TX antennas. Encased in rugged enclosures for extreme environments, our proprietary products utilize an ultra-low noise amplifier to boost low power and/or distant signals received by the antenna as much as 13.6 dB.

Incorporated in all Narda units are our advanced low-loss cavity filters or duplexers. They significantly improve the carrier-to-noise ratio of the signal. Our tower top amplifiers can also be provided with our CATS Monitoring Systems. If VSWR is exceeded or transmitted power falls below user-defined threshold levels, you'll be alerted.

Once our system is installed, the benefits are unbeatable. With stronger and better signals, you'll connect with customers over a wider area. Uplink co-channel interference will be reduced. An improved C/N ratio will cut back dropped calls dramatically. Even the battery life of your customers' phones will be lengthened.

The Narda tower top antenna amplifier systems. For expanded cell coverage, improved performance and enhanced customer satisfaction—you're covered.

Call Narda today at **516-231-1700**. Or call our Faxback and ask for document 1120 at **1-800-4NARDANY**.

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microwave-east
an L3 communications company
It's Narda to be precise.

NQA ISO9001

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Circle (52) on Fast Fact Card

Protek jr+ site monitor.
New products
Protek 24+ site monitor; Protek jr+ SNMP site monitor; gatekeeper remote site access control system.
Circle 322

Penta **Booth 149**
Existing products
Dispatch and public address consoles; Windows NT software; features such as caller ID, ANI/ALI, TDD interfacing and more.
New products
LCD dispatch consoles.
Circle 323

Pipo Communications **Booth 2101**
Existing products
High-speed DTMF signaling encoders; keypads with sealed gold contacts and memory options; encoder module: AE-1 — two memories (ANI/ENI).
New products
High-speed DTMF signaling encoder module: AE-2 (six memories).
Circle 324 See classified ads

Premier Communications **Booth 530**
Existing products
Speaker microphones; headset microphones; lapel microphones and throat microphones for many models of two-way radio.
New products
VHF and UHF two-way radios; after-market NiCd and NiMH battery packs for two-way radio; universal battery chargers.
Circle 325

Primus Electronics **Booth 760**
Existing products
Microphones; dc remotes; cable; connectors; hardware; leather cases; mobile antennas; lightning protection; radio mounts; accessories; power supplies; surge protectors; uninterruptible power supplies.
Circle 326 See ad page 32F

Prism Telecom Div./ TGA Technologies **Booth 452**
Existing products
Prism Lite remote trunk concentrator; Prism III radio paging terminal; Prism TxBSC transmitter/base station controller.
New products
Prism Voice Trac voice/fax messaging; single number server, email, debit/pre-paid services platform.
Circle 327

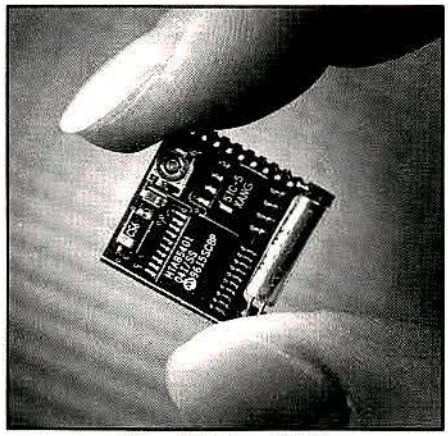
Pulse Power **Booth 1249**
Existing products
Charging systems for cellular, camcorder and specialty applications using negative pulse micro-conditioning technology.
New products
Negative pulse micro-conditioning charging systems for two-way radios for Motorola, Bendix-King, GE, Kenwood, Maxon and Yaesu.
Circle 328

Pyramid Communications **Booth 2507**
Existing products
SUR-200 vehicular repeaters; SC-138 SCADA telemetry controller; VHF telemetry module.
New products
SUR-200 800MHz vehicular repeater; 2012 mobile status reporter.
Circle 329

Radio Dealers Leasing **Booth 1914**
Existing products
Leasing and financing programs for dealers, distributors, manufacturers and end-user customers nationwide; customized programs available.
Circle 331

RadioMate **Booth 2128**
Existing products
Headsets and audio accessories for analog and digital radios.
New products
Several models of handsets for digital and

Digital ANI: Compatible with Motorola® MDC-1200®



Micro-Miniature ID-12

Manufactured by Control Signal®, the ID-12 ANI encoder is a cost-effective way to upgrade all the radios in your fleet with ANI that is compatible with Motorola MDC-1200. Works in all radios, and its tiny size (.59" x .65" x .12") allows it to fit in virtually all hand-helds. Has leading and trailing IDs, emergency, and time-out timer. Fleet price (100 qty) $89 ea.

Call 800-521-2203

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QUALITY•SERVICE•PRICE

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FOR THE 150, 450, & 850 MHz BANDS

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Vincent Van Gogh:
Sunflowers (1888)

The Original Beats Any Imitation



The inventor's know-how and more than 40 years of experience in RF technology make every single SUHNER lightning protector an unsurpassed original.

- SUHNER – the specialist for lightning protection in wireless communications
- Outstanding RF and passive intermodulation performance
- Products IM-tested, with certificate on request
- Maximum protection and reliability
- Products capable of handling the powerful "direct strike" test pulse of 10/350 µs
- Very flexible in meeting our customers' technical and delivery requirements

Choose the Reliability and Safety of the Original!
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Circle (34) on Fast Fact Card

PCS radios, some small and discreet, others for high ambient noise areas.
Circle 332

***Radio Resource*/Pandata** **Booth 2316**
Existing products
Publication for radio communication systems managers; *Radio Resource International*, providing practical information for distribution organizations and large users of private and trunked radio worldwide.
Circle 333

RadioSoft **Booth 155**
Existing products
ComStudy 1.50 propagation software for two-way, cellular, paging, SMR, RCC, broadcast AM/FM/TV.
Circle 334

Raine **Booth 2035**
Existing products
Nylon cases for two-way radios, cellular phones and pagers.
New products
Two-way radio cases with a metal-to-metal swivel belt loop: #52RV 4½" bucket, #52RV2 3½" bucket.
Circle 335

RF Industries **Booth 528**
Existing products
BNC-RFB 1100 series; corrugated cable connectors; RFA-4000 series kits and accessories; TNC-1200 series; mini UHF RFU 600 series; UHF RFU-500 series.
New products
7/16 DIN RFD-1600 series; SMA reverse gender connectors 3200 series; 50Ω toggle switch attenuator; RSA-300X and RSA 3010 right-angle SMA crimp plug and straight SMA crimp plug.
Circle 336

RF Design **Booth 1300**
Existing products
RF Design serves engineers who design radio frequency equipment used for wireless communications and for industrial, medical and military purposes. Examples include wireless telephone and LANs, pagers, medical radiology equipment and transmitters and receivers.
Circle 337 See ad pages 81 & 83

RF Imaging and Communications **Booth 2033**
Existing products
Radio service monitors; cellular analyzers; power meters; spectrum analyzers; scopes and general test equipment; Motorola, IFR, Wavetek, Cushman, Stabilock, H-P.
Circle 338 See classified ads

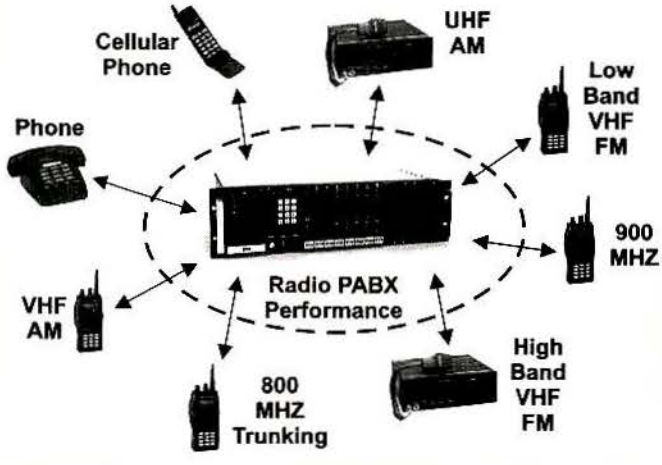
Ridgewater College **Booth 459**
Existing products
Formerly Willmar Technical College, trains two-way radio and wireless technology technicians, since 1967; two-year curriculum and laboratory are continually updated to provide graduates and employees with well-trained people to maintain and repair communications equipment.
Circle 339 See classified ads

Ritron **Booth 416**
Existing products
UHF trunking portables; UHF trunking mobiles; job site base/intercom; job site status reporter.
New products
Patriot SST-450-LTR, RTX-450-LTR, RPM-450-LTR; Jobcom JBS-150.
Circle 340 See ad pages 89 & 91

RoameR One **Booth 700**
Existing products
Mobile radio airtime services; model 75-3015 LM technology 12-channel two-way radio for voice dispatch complies with FCC and proposed guidelines for spectrum efficiency; model 75-3115 LM technology 99-channel two-way radio for voice dispatch and data communications, complies with FCC and proposed guidelines for spectrum efficiency.
Circle 341 See ad page 37

Cross-connect 12 different radios at one time!

ACU-1000
Intelligent Interconnect System



- Interfaces VHF, UHF, Cellular and Telephone Systems.
- Multiple Simultaneous Two-Way or Conference Calls.
- Unmanned Operation Permits Selecting Cross-Connections from Remote Radios.
- Built-In Voice Prompts Guide Users to Operation of System.
- Cross-Connects Trunking Talk Groups to Conventional Radio Nets.
- Sophisticated DSP Algorithms Provide Adaptive Hybrid, Voice Modulation Recognition VOX, and Noise Reduction.
- Optional Console Software Provides Full System Status and Control.

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Phone: (919) 790-1011 • Fax: (919) 790-1456 • Tech Line: (919) 790-1048
http:\\www.jps.com • Internet: jps@jps.com

JPS Communications, Inc.

Circle (35) on Fast Fact Card

THE LID'S OFF

Jammed-Up Repeater Networks



Now convert your crowded UHF community repeaters into a subscriber-efficient trunking system. Thanks to SmarTrunk Systems, Inc., you can handle the change-over WITHOUT INTERRUPTING NORMAL SERVICE. SmarTrunk II is a fully compliant, digitally-based trunking system that can be installed in parallel with your current system while upgrade occurs. Most important, SmarTrunk II has a proven track record in thousands of systems world-wide. In fact, such key players as Motorola, Kenwood, Yaesu and Alinco have adopted SmarTrunk II as a low cost UHF trunking solution.

The heart of the system, the SmarTrunk II Controller, offers such features as programmable call limit timers on a per user basis, radio kill for non-paying users, and the storage of complete call record accounting information. Custom trunking logic boards are available for a wide range of mobile and portable radios.

Bonus Features Abound!

- Supports individual calls, group calls and telephone interconnect
- Up to 4,000 group or individual I.D.s per system
- Proprietary digital signalling eliminates non-paying radios
- System privacy—other system users cannot eavesdrop
- Capable of operating in environments with co-channel users
- Supports gradual conversion from conventional to trunked operation

SmarTrunk Systems, Inc.

Circle (36) on Fast Fact Card

There's Lots More, Call or Write:

SmarTrunk Systems, Inc.
23278 Bernhardt Street • Hayward, CA, USA 94545-1621
Phone: Toll Free (800) 291-7428 or (510) 887-1950 • Fax (510) 887-4011
Email: salesinfo@smartrunk.com • Web Site: http://www.smartrunk.com

Rohde & Schwarz **Booth 944**
Existing products
Accessnet contact, MPT-1327 trunked radio system; REM-227 MAP-27 console; REM-210 standard LMR console.
New products
Accessnet-D digital MPT-1327 trunked radio system.
Circle 330

Ruf*Nek Building Systems **Booth 1226**
Existing products
600 series concrete equipment shelter; 300 series fiberglass equipment shelter.
New products
Series 700 fire-resistant roof-mount equipment shelter.
Circle 342

Samlex America **Booth 1245**
Existing products
Regulated dc power supplies; dc-to-ac inverters; dc voltage converters; switching power supplies; cellular/charger power supply.
New products
SEC 1223 23A base station power supply; base station radio cabinets; PSE 12250 2500W dc-to-ac inverter; SDC 23 23A 24Vdc–12Vdc converter.
Circle 343

Satellite Communications **Booth 1300**
Existing products
Satellite Communications magazine covers technology development and deployment for professionals who plan, build, buy and use satellite communications services, systems and products. Now in its 21st year, Satellite Communications is committed to quality and leadership in providing vital information to its 21,000+ readers. It is also the official sponsor of the Satellite Communications Expo & Conference, Sept. 23–25, 1998, in Washington, DC.
Circle 344

Scientific Dimensions **Booth 2302**
Existing products
SDI 7200 police console mount; SDI M8003 heavy-duty laptop computer pedestal mount; SDI 1050 slide mount; SDI 8590 keyboard holder (quick release).
New products
SDI 8800 universal docking station Panasonic CF25; SDI 8620 docking station for the Fujitsu 1200; SDI 7250 utility van mobile office mount.
Circle 345

Selectone Booth 935
Existing products
Voice encryption (scramblers) CTCSS; DTMF; burst tone; two-tone sequential; ANI; remote-control shared repeater panel.
New products
Advantage-plus time domain encryption (scramblers); ST-804/ST-888 ANI products; ST-809 DTMF board.
Circle 346 See ad page 58

Setcom Booth 2409
Existing products
Vehicular intercom systems; headsets and communications accessories for police, fire, EMS and industrial use.
Circle 347 See ad page 36

Sharp Communications Booth 622
Existing products
Ericsson two-way radios; Whelen lightbar products; Comm Shop LMR software; Go Comm pagers.
Circle 348 See classified ads

Shure Brothers Booth 1753
Existing products
Modulink series of interchangeable microphones and cords for two-way radios, featuring the 590T, 592T, 550T, 885TT and 888TT.
New products
Hand-held microphone 596T designed as a general replacement for most OEM microphones.
Circle 349 See ad page 29

TELEWAVE, INC.
Engineers and Manufacturers Since 1972

See us at IWCE
Booth # 1808

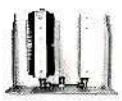
Antennas and Power Dividers
60 - 2500 MHz
TXYLAN coating resists corrosive environments
500 Watt power handling
Full fiberglass radomes



Transmitter Combiners and Duplexers
138 - 1300 MHz
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Autotuning with Ceramic Enhancement



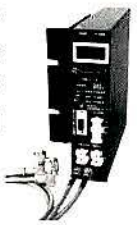
Filters and Preselectors
30 - 960 MHz
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Dual-Window and Dual-Band available
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Remote Monitoring Equipment
138 - 960 MHz
Software control and alarm outputs
Antenna VSWR and RF power display
RS-232 / RS-485 control



Wattmeters and Test Loads
2 - 2500 MHz
Broadband design - No slugs or inserts
Shock-resistant mounting
Forward or Reverse power switchable

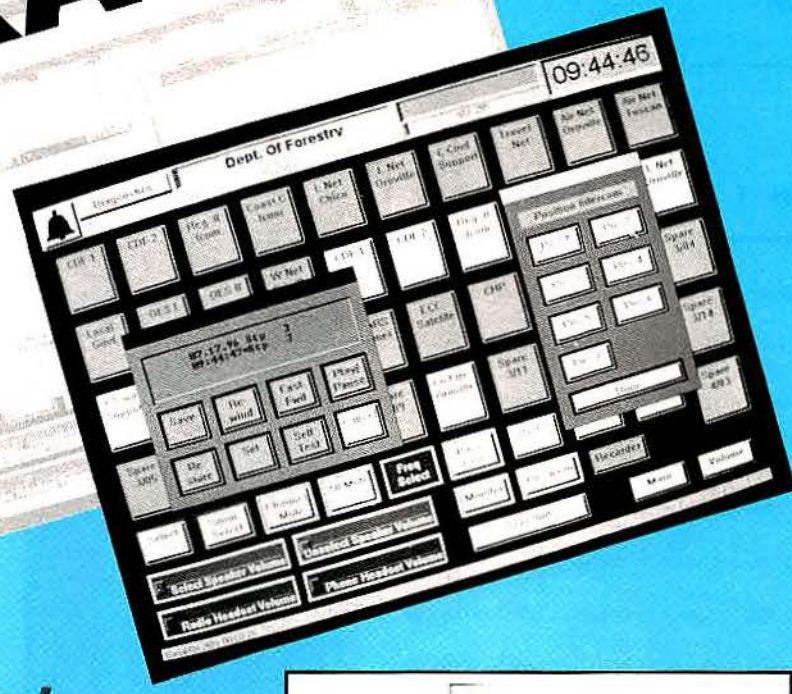




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http://www.telewaveinc.com • sales@telewaveinc.com

Circle (37) on Fast Fact Card

The New ULTRA-COM NT



Windows-Based Radio Dispatch Console System

...offering more built-in programmability than any other system



The Windows-based Ultra-COM NT is the only communications workstation that lets you design screens to your specific operating requirements, with no changes to software and no re-programming costs.

The Ultra-COM NT's design whether stand-alone or as part of multi-position consoles sharing common electronics, takes advantage of the latest advances in computer technology through the use of CPLDs (Complex Programmable Logic Devices), and DSP (Digital Signal Processors) to provide precision audio filtering and routing.

In addition to the exclusive "Screenmaker" and "Customizer" programs, the new "MEDIC" diagnostic program provides extensive diagnostic tests to identify hardware and software problems, *and recommends corrective action.*

Moducom NT dispatch consoles, with Windows-based technology, are designed for today's emergency communications requirements - and for the future.

MODULAR COMMUNICATION SYSTEMS, INC.

13309 Saticoy St., No. Hollywood, CA 91605
(818) 764-1333 / Fax (818) 764-1992
www.moducom.com

Windows NT is a Trademark of Microsoft Corporation

Visit us at IWCE Booth 2128.

Circle (55) on Fast Fact Card

Sigtec America **Booth 1408**
Existing products
Series T-8000 fully automated mobile data dispatch system; computer-aided dispatch systems; series G4551 Mobitag GPS/AVL automatic vehicle location system; mobile data and signaling products.
New products
G4554 Mobitag mobile AVL system with dead reckoning and ABS (reverse differential).
Circle 350

Sinclair Technologies **Booth 1132**
Existing products
RTC-5800 vertical PCS antenna, combine duplexer; crossband coupler.
New products
Polarization diversity PCS band antennas-SX-50S series.
Circle 351 See ad page 50

Slattery Software **Booth 1328**
Existing products
FCC licensing software for FCC forms 600, 415, 489, 159, FAA-7460.
New products
Quickform, version 10.
Circle 352 See classified ads

SmartLink Development **Booth 1522**
Existing products
Smartlink multiprotocol trunking and networking system; Smartmail voicemail system; Sitelink digital multiplexer.
New products
LTR-Net enhanced protocol; Smartmail voicemail system.
Circle 353

SmarTrunk Systems **Booth 918**
Existing products
Smartrunk II ST-853 trunking controller; Smartrunk II logic boards with omni feature set; Skylink wireless local loop system; Skylink ST-880 remote subscriber unit.
Circle 354 See ad page 63

SoftWright **Booth 2320**
Existing products
Terrain analysis package (TAP) 4.0; Site Base for Windows; intermodulation study programs.
New products
Aggregate coverage module (AC); antenna elevation module (AE); Hata/Davidson propagation module (HD); Egli propagation module (EG).
Circle 355 See classified ads

Sonic Communications **Booth 109**
Existing products
Headsets; ear mics; throat mics; helmet communications for motorcycles, automobiles and bicycle patrols; security kits; wireless receivers; various surveillance equipment.
New products
CA21 new two-wire palm mic kit; ERS602 slimmer ear microphone; MHSPTT multiple headset/PTT; Computer Viper Headset speaker/mic for computer.
Circle 356

South Midlands Communications **Booth 2137**
Existing products
The Hilmast range of pneumatic telescopic masts meeting MIL-STD E.
New products
Tactical pneumatic masts.
Circle 357

SpaceCom Systems **Booth 438**
Existing products
Hypercubed satellite technology and receiver, FM cubed satellite technology and receiver; point-to-multipoint satellite communications for paging networks.
Circle 358

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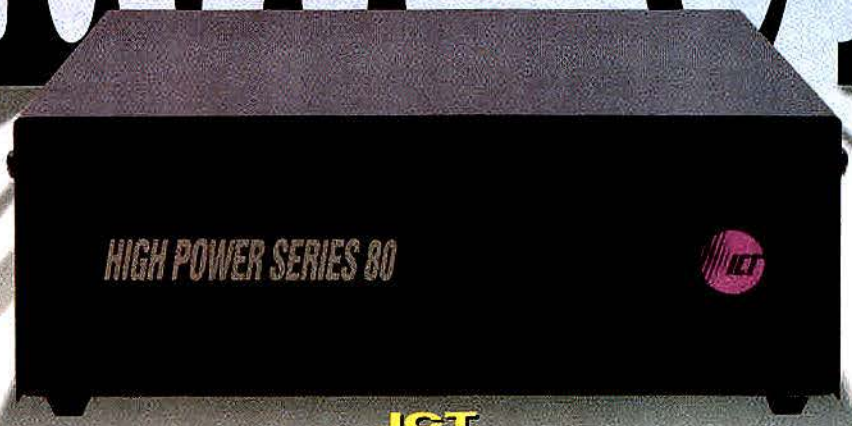
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Circle 359

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Existing products
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New products
Internal communications solutions (RF shaded area products and engineering); power solutions (solar power centers).
Circle 360

TCC Industries **Booth 1323**
Existing products
N, TNC, SMA, series reverse-polarity and reverse-thread connectors.
New products
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Circle 361

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Circle 362

Telecom Towers **Booth 1570**
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Circle 363

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New products
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Circle 364

Telemobile **Booth 1218**
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Ptel Phonelink wireless point-to-point system; Dtel digital 2+1 Phonelink; System 35 wireless PASX/radio trunking system; Web site *www.telemobile.com*.
New products
Qtel "quad" four-line Phonelink; Etel 2MB 400MHz, 1.5GHz microwave, Goto3 interface; T738 line concentrator/pain gain system for 160, 336 or 512 lines.
Circle 365

Telewave **Booth 1808**
Existing products
M107-860 high-power trunking combiner; TATC-8645-1HP high-power autotune combiner; PMU1C15 remote power/VSMR monitor; ANT860Y10E yagi antenna 860MHz 10dBd.
New products
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Circle 366 See ad page 64

Telex Communications **Booth 2015**
Existing products
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New products
Stinger headsets.
Circle 367

TESSCO **Booth 1034**
Existing products
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Circle 368 See ad page 13

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Circle 369

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Circle 371 See ad page 70

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Circle 372 See ad page 21

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Trilogy Communications Booth 453
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New products
Aircell radiating plenum: RMC2-50-500P.
Circle 374 See ad page 17

Trimble Navigation Booth 1052
Existing products
Crosscheck AMPS cellular, an intelligent mobile unit with integrated GPS and cellular transceiver; Placer GPS 450/455 intelligent GPS mobile sensors with communications support and optional dead reckoning.
New products
FleetVision 3.0 for Windows, a base station solution to manage standard fleet options.
Circle 375

Tru-Connector Booth 455
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New products
QDS series connectors for 0.141 semi-rigid cable.
Circle 376

TX RX Systems Booth 309
Existing products
Signal boosters; multicouplers; cavity filters; duplexers, RF system products; tower-mount preamps.
New products
101-90-08 series base station antenna.
Circle 377 See ad page 3

VCP International Booth 2205
Existing products
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Vega, a Mark IV Company Booth 1900
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Circle 379 See ad page 12

VoCom Products Booth 1656
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New products
100W and 200W 900MHz amplifiers; ac powered amplifiers.
Circle 380 See ad page 82

W&W Associates Booth 1314
Existing products
Replacement batteries for two-way radios; chargers for communication batteries; analyzers/conditioners for two-way radios; cellular phones and camcorders.
New products
Analyzer I (single station analyzer/conditioner); new batteries for Motorola P1225, Nextel Raven, Uniden SP801, Maxon SP120, Icom IC-F3 and IC-F30LT, E.F. Johnson Viking CX/CR and Avenger S1 and Standard HX381.
Circle 381 See ad pages 32A & 49

Wacom Products Booth 2308
Existing products
Cavities; duplexers; combiners; receiver multicouplers; isolators; load terminations.
New products
Model WP-6953, a six-cavity bandpass

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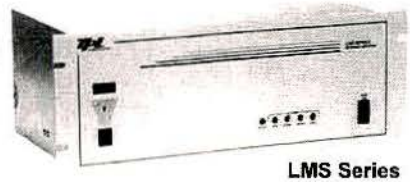
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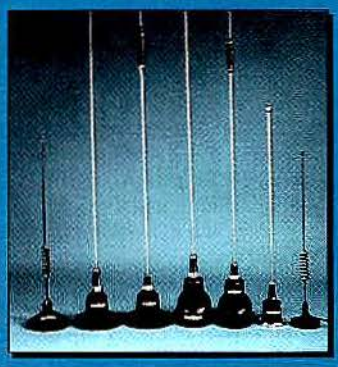


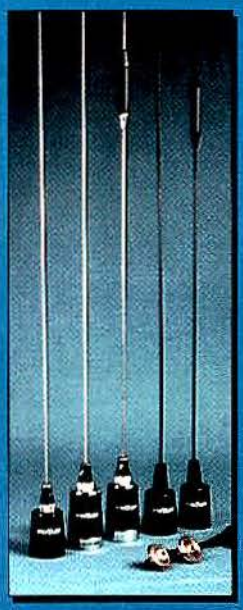


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Circle 382 See ad page 60

Wireless Review Booth 1300
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Wireless Review is published twice monthly for carriers in the competitive wireless communications market, including those who provide service for cellular, PCS, paging and ESMR. Features focus on the site, revenue and network managements, with regular columns about test and measurement, sales channels, enhanced services and regulatory issues.
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New products
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Circle 386

Zetron Booth 2208
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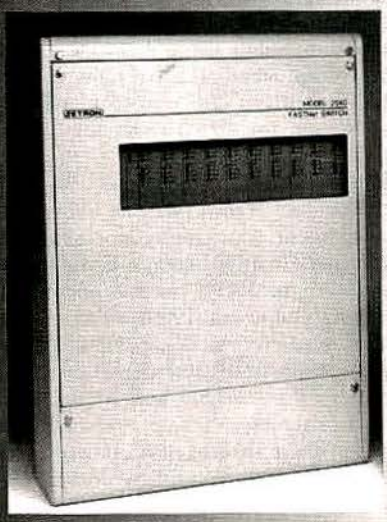
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Paging infrastructure: The agent, the manager, and the MIB

RF site equipment, adapted to use a network management protocol, can provide paging carriers with redundant communications paths for site monitoring and information distribution. Troubleshooting, control and programming of the equipment can be performed from a centralized location.

By Michael Ball

During the past few years, the nature of telecommunications has changed dramatically. The recent aggressive growth of nationwide paging networks and the introduction of advanced messaging technologies have resulted in dramatic changes in site management needs.

Systems engineering is required to support greatly expanded coverage areas while technical staffing is held constant—or even reduced. Simultaneously, new technology is frequently demanding more, rather than less, attention during the early stages of implementation. This situation would seem to demand an increased reliance on remote monitoring and control of site infrastructure. Indeed, a number of carriers are transferring some site monitoring responsibility to the regional network operations centers that monitor their network performance.

However, carriers are finding that while some infrastructure manufacturers offer network access via proprietory methods, much ancillary site equipment remains isolated from network access. Indeed, most monitoring equipment manufacturers historically serving the paging industry still rely upon the public switched telephone network (PSTN) or RF links for communications with the site. Existing monitoring methodology must be reevaluated.

Voltage level signals and tone control

In the early days, remote site control was generally accomplished by current or voltage level signaling over dedicated lines. While this was adequate for PTT or channel-select functionality, there was no capability to report unanticipated changes of operational parameters. Control functionality was severely limited by the restricted command set that was possible.

To remedy this situation, a variety of tone control systems were introduced, and remote control by PSTN or radio link became possible. Reporting from the site was still restricted, however, because a condition could be reported but a specific parameter could not. For example, you might know that a transmitter was keyed, but you wouldn't know that transmission line voltage standing wave ratio was excessive. Truly useful remote monitoring had to wait for digital technology.

Modem control

It could be argued that true remote site management was simply not available until cost-effective modem communications over the PSTN became possible.

In the mid-to-late-1980s, several companies released devices capable of reporting the status of discrete digital or analog inputs in a reasonably user-friendly format to a remote VDT, printer or pager. Most of these devices also allowed some degree of remote control by contact closure or relay driver. Such systems were faster, friendlier and offered at least partial path redundancy because communication was no longer limited to a dedicated connection to a single control point. Such systems could call a variety of phone numbers and communicate via modem, voice synthesizer or pager.

These systems are still limited by an over-reliance on a functioning "plain old telephone service" (POTS) line at the site, but they were a tremendous advantage

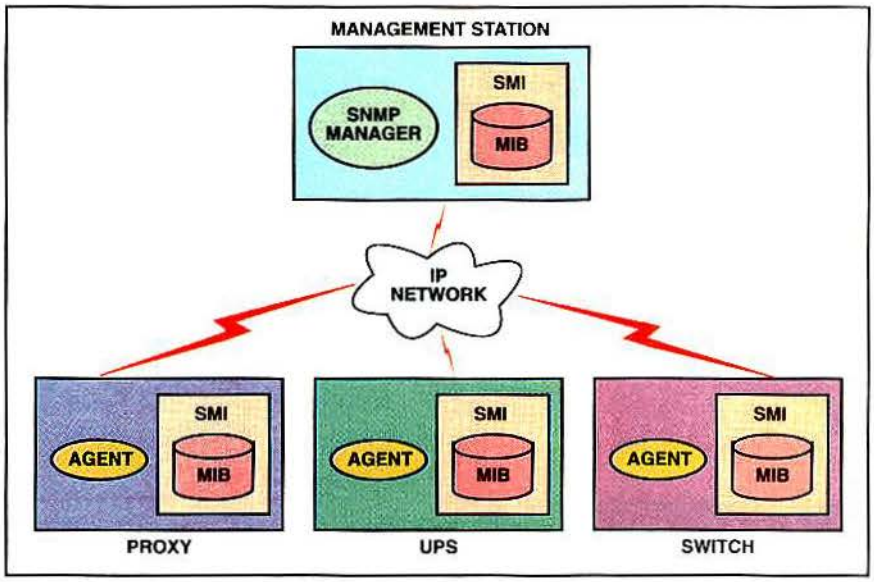


Figure 1. Diagram of a generic Simple Network Management Protocol management system.

Ball, a certified technician, is general manager for PageTek, Raleigh, NC. His email address is: *pagetek@mindspring.com/pagetek*.

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when communication from switch to transmitter site was primarily accomplished by leased lines or RF links.

TCP/IP protocol

The modem monitoring approach is still adequate for many users, but the emerging use of nationwide Transmission Control Protocol/Internet Protocol (TCP/IP) data networks by paging carriers presents new demands for the telecommunications professional and new opportunities for remote monitoring equipment manufacturers. As paging carriers find data communications via wide-area network technically desirable, they understandably wish to integrate their site-monitoring equipment within that network.

Indeed, the Personal Communications Industry Association's (PCIA) "Guidelines for Implementations of the TCP/IP Protocol Suite" state that "The protocol and procedures, while not mandatory, are important tools that are applicable to paging networks, particularly larger networks."

For this reason, there is renewed interest in the *Simple Network Management Protocol* (SNMP), the predominant network management tool on IP networks. PCIA's guidelines state that "The use of the Internet network management features should be advantageous to most paging networks," and that "SNMP has emerged as the management agent of choice."

Setting standards

A number of proprietary network management methods have evolved over the years, but the need for a management standard was early recognized as a mandatory element of TCP/IP networks. The Internet Engineering Task Force adopted SNMP in April 1989 as an interim management technique to be used until the International Standards Organization Common Management Information Protocol (CMIP) was fully implemented.

In reality, the success of the SNMP standard, and the sluggish implementation of CMIP, has resulted in SNMP remaining the most common monitoring protocol on IP networks. It is now generally accepted that SNMP will remain a useful component of IP-based monitoring for some years to come.

SNMP structure

The protocol comprises three basic components: the agent, the manager and the management information base (MIB). The agent software resides in a managed element of the network where it collects data, responds to commands from the SNMP manager and sends alerts (called traps) to a specified IP address. The manager software polls the agents at specified intervals, listens for traps, retains the information for analysis and presents the resultant information to the NOC staff in a user-friendly way. The information reported by the agent is specified in the agent's MIB, which resides within an agent that organizes those parameters that are to be monitored and/or controlled by the SNMP manager. Support for any device, including one emerging or currently non-existent, can be implemented by the development of a MIB for that device and an associated configuration file for the SNMP manager.

SNMP adoption

Acceptance of SNMP among infrastructure manufacturers is growing. The protocol offers platform and vender independence, flexibility and coexistence with a variety of proprietary approaches such as Netbios, SNA, and Netware. Support is routinely available for access servers,

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routers, UPS, switches and other network devices. Manufacturers of related equipment are adding such support to allow easier integration within a networked environment. Still, a substantial base of current RF site equipment offers no SNMP capability and will effectively remain inaccessible by network without a suitable hardware interface to the IP network. This issue can be resolved by using a *proxy*, which is a device that functions as an agent for equipment that does not offer SNMP management capabilities. An SNMP proxy such as the ProTek jr+SNMP will allow IP access to such equipment.

Proxy application

The SNMP proxy can be installed on one port of an access server located at the site. Other networked devices at the site can share the remaining ports. The proxy can, with suitable programming, monitor any legacy equipment outputting system status via discrete logical state, voltage or serial ASCII stream. Possible bi-state (digital) inputs include contact closure or logic levels from intrusion or fire alarms, power supplies, PTT lines, COR lines, tower light controllers and similar inputs. Analog inputs monitor voltage levels, or, by use of appropriate sensors, RF power, current, temperature or other linear inputs. The proxy also can access many transmitters, controllers, and ASCII stream devices that offer an RS-232 port for troubleshooting, control or programming. Additionally the jr+SNMP, by retaining full POTS line capability, provides redundant communications capability via an onboard modem to a remote VDT, printer or paging terminal. In the absence of a POTS line, cellular or RF-modem communications are possible. If a continuous IP connection is not available, SNMP monitoring via dialup networking to a site-local IP service provider is still possible, although at the cost of redundant communications channels. This redundancy of communication allows the support staff to retain communications with the site even if a critical IP network segment goes down.

Centralized monitoring

An SNMP manager running on a workstation at the centralized NOC communicates via an IP network with the SNMP proxy at the sites to be monitored. The manager polls the agents at specified intervals and displays the information at the same management station used to monitor

Communication between the proxy agent and the SNMP manager uses five commands:

❶ *Get request.* The manager requests the value stored in a specific MIB.

❷ *Get-next.* A manager may use this command when requesting multiple sequential fields of data, to conserve bandwidth.

❸ *Set request.* The manager requests that a value be stored within the managed MIB; i.e., a command is given.

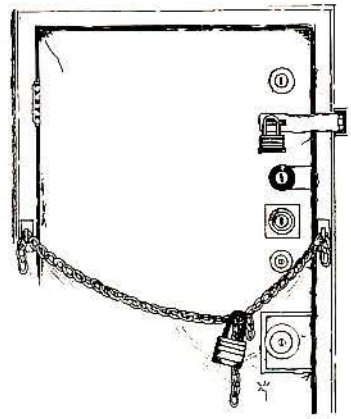
❹ *Get-response message.* The agent responds to a manager request

❺ *Trap message.* The agent sends a trap to the manager when a monitored parameter reached a trip point.

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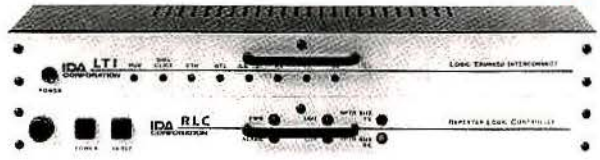
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any other SNMP device on the network. The information can be distributed throughout the NOC by local-area networks (LAN); it can be logged for future analysis; and it can be made available to repair-order-generation and tracking software on receipt of a trap.

With the introduction of such a system, paging carriers can now gain redundant communications paths for site monitoring, facilitate distribution of such information throughout the organization, and access equipment that would otherwise be unavailable by network.

Summary

Network management using agent-assisted SNMP adheres to a stable standard that should be available for years to come. The approach increases redundancy and extends access. It also integrates into existing network management systems gracefully, with little or no changes to existing NOC procedures.

Further reading

All of the technical aspects of the Internet protocol and SNMP are covered by the Request for Comment (RFC) documents published by the Internet Engineering Task Force (IETF). RFCs are available for downloading at *www.isi.edu*.

Documents particularly pertinent to SNMP are RFC1155 ("Structure and Identification of Management Information for TCP/IP-based Internets"), RFC1157 ("A Simple Network Management Protocol"), RFC1158 ("Management Information Base for Network Management of TCP/IP-based Internets: MIB-II") and RFC1212 ("Concise MIB Definitions").

ASN.1 and the basic encoding rules are not described in RFCs. For information on these subjects, see "A Layman's Guide to a Subset of ASN.1, BER, and DER," at *www.rsa.com/rsalabs/pubs/PKCS/*.

For an overview of SNMP network monitoring in general, refer to *SNMP, SNMPv2, and RMON: Practical Network Management*, by William Stallings (Addison-Wesley, 1996).

The PCIA's Paging Technical Committee has published guidelines for those involved in networking for telecommunications applications. "The PCIA Guidelines for Implementations of the TCP/IP Protocol Suite" directly addresses the use of IP networks in support of the TIPP protocol. The PCIA TIPP and TDP specifications address paging networking in general. The committee, at the time of the standards' publication, comprised major infrastructure manufacturers and carriers.

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(continued from page 8)

For this reason, any intermod that is generated is most likely generated in the receiver front end rather than within the preamplifier itself. However, the introduction of *gain* ahead of the receiver front end can cause intermod to be produced within the receiver. This is because the preamplifier increases the level of any potential intermod-forming signals at the front end of the receiver. Thus, any intermod signals that were formed in the receiver before the introduction of the preamplifier may not have been noticeable because they were of such low level—below the sensitivity of the receiver.

An example will help to clarify this point. In the upper part of Figure 2 on page 8, two signals (A and B) are applied to the receiver input. Signal A is at −40dBm and signal B is at −30dBm. In the front end of the receiver the two signals produce intermod signals where 2A−B is at a level of −140dBm and 2B−A is at a level of −130dBm. These intermod signals are not a problem because they are well below the receiver threshold. For all practical purposes, they do not exist.

Correction

Due to a typesetting error, the power density figures given on page 40 of the March 1997 "Technically Speaking" column were set as "V/m^2." The correct form should have been "W/m^2" (watts per meter squared).

In the lower part of Figure 2, a preamplifier is added before the receiver. This drastically changes the intermod situation. Because the preamplifier has a gain of 20dB, each of the signals (A and B) is at a 20dB higher level at the receiver input. Thus, A is at −20dBm, and B is at −10dBm. Now, the intermod signals formed in the receiver front end are at a much higher level. Intermod signal 2A−B is at −80dBm and 2B−A is at −70dBm. These intermod signals are of such high levels that severe interference can result.

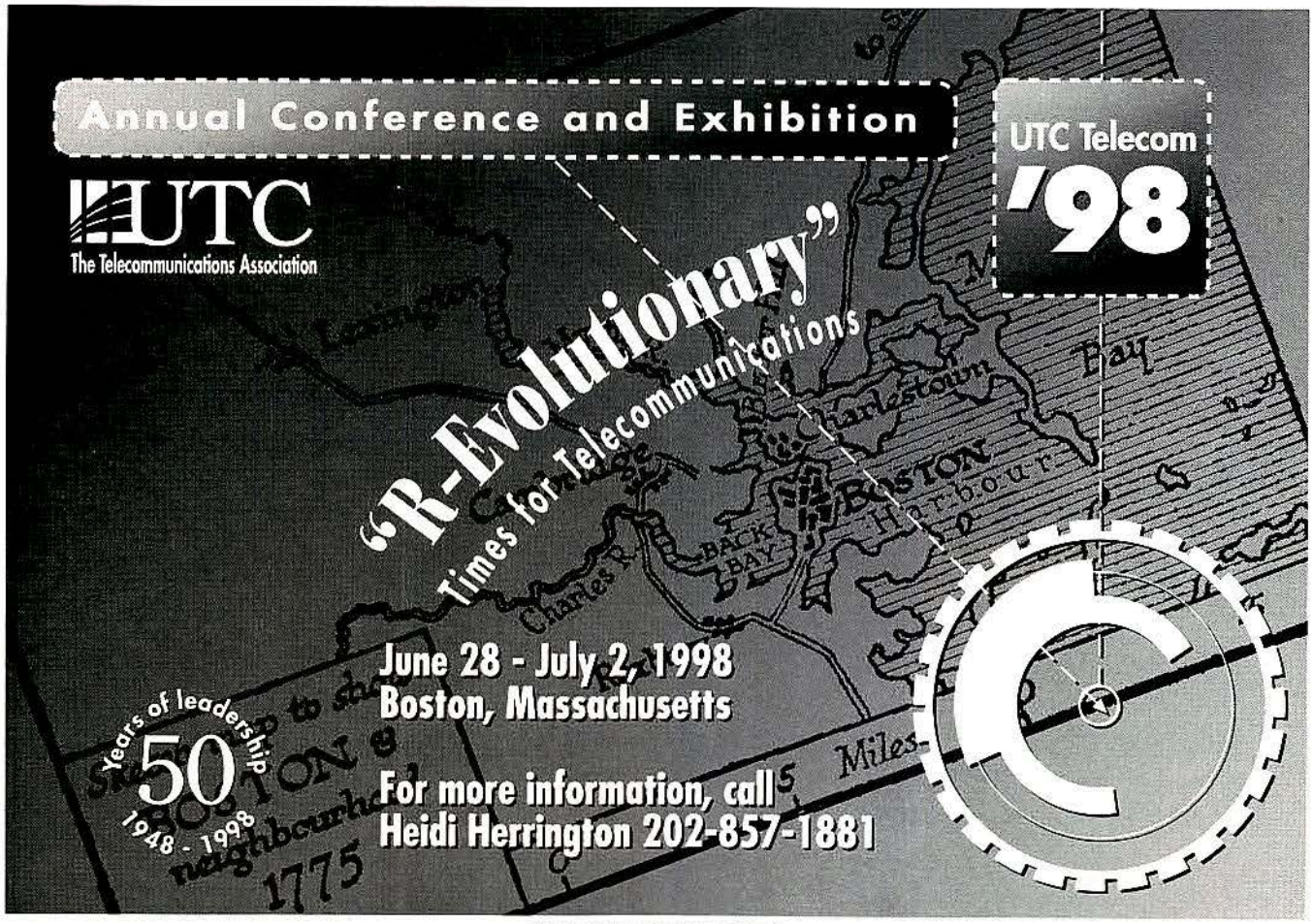
Desensitization

Because the amplifier will increase the signal levels at the input to the receiver, it is important to be aware of possible receiver desensitization due to strong signals on a frequency nearby. If a signal on a nearby frequency is 20dB below the *desense* level, then a 20dB preamp will put that signal at the desense point of the receiver.

Summary

In the right situation, a tower-top preamplifier can really boost your receiver *system* sensitivity. But, before going to the expense of installing a tower-top amplifier, perform tests to determine whether or not this is a viable option. Otherwise, you might achieve a little gain in system sensitivity but sacrifice much in the intermod and desense factors. Such considerations are especially important at multitransmitter sites. If you do find that the tower-top preamp is a viable option, don't consider *gain* alone. Get one with the best noise figure and intermod rejection figure (third-order intercept point) that you can fit into your budget.

Until next time—*stay tuned!*



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Gettin' ready for Vegas

By Robert H. Schwaninger Jr.

Are you going to the IWCE show in Las Vegas? I am. I always do. There's something about going to a show that isn't sponsored by a trade association, pushing its own agenda, that I like. Okay, there still will be a lot of association types, hawking their groups' priorities, but at least the whole show isn't devoted to how "God-awful wonderful" their group might be.

IWCE is the one show that provides you with a true cross section of the land mobile industry: trunking, paging, simplex, cellular, PCS and more. There's a little bit of everything at the show. Everyone's invited. Nobody's made to feel unwelcome, and the variety of attendees, exhibitors and speakers makes it a worthwhile show for everyone. (It may be the only show left where the attendees vastly outnumber the exhibitors.)

For example, if you think that AMTA* is the real deal, you can hook up with Alan Shark and see what he and his dual groups AMTA/IMTA are doing about making trunking a household word—like succotash. If it uses a common controller, Shark's all over it. Lately, AMTA's been trying to get a better deal for the 220MHz–222MHz auction. It may not get him the decision he wants, but it sure puts Shark's mug in the trade publications.

Some PCIA* guys also will be hanging around, asking you what the heck you're doing talking to Alan Shark. Lately, a "kinder and gentler" PCIA has been speaking about the "disenfranchised small operator." Seems they've dropped their emphasis on providing an "exit strategy" for small businesses and are beginning to renew their once-waning commitment to local operators. I guess their earlier advice just wasn't heeded—or needed.

Harold O'Dell and Walter Gallinghouse will be working the rooms on behalf of SMR Won*. After being in stasis for a



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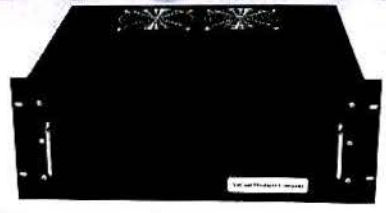
*AMTA: American Mobile Telecommunications Association; IMTA: International Mobile Telecommunications Association

*PCIA: Personal Communications Industry Association.

*SMR Won: Specialized Mobile Radio Wireless Operators Network.

Schwaninger, *MRT's* regulatory consultant, is a partner in the law firm of Brown and Schwaninger, Washington, DC. He is a member of the Radio Club of America. He is general counsel in the business operated by Jim Fryer.

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time with the now-defunct "consensus proposal," the group is swinging hard against the 800MHz auction in the U.S. Court of Appeals. Walter always said that if the FCC didn't adopt the compromise, SMR Won would head to the court.

I like a man of his word. In our industry, they're too rare.

Mark Crosby of ITA* usually drops by in all of his sartorial splendor. I like Mark. He is committed to his organization and is moving his group's agenda as far as possible before Congress and the FCC. He's smart, funny and edgy. I guess my only hesitation is that I've never witnessed ITA going to the mat for anything. Seems like ITA is loud and proud, then falls just short of drawing the line when compromise doesn't seem to be an option. (Maybe Mark's just wiser than I am.)

There usually are a few APCO* guys around. They're the ones that are really *listening* at all the technical sessions and ducking out of the more political stuff. It must be nice to be the fair-haired damsels of Congress, with spectrum to burn. But then again, public safety usually shows up at the tables with a budget too small to gamble recklessly.

Lonnie Danchik will be making the rounds for SBT*, extolling members with the group's commitment to small business. It's tough stuff organizing small businesses into a cohesive unit with increasing political power. Lonnie tells me that he's so busy loading ex-Nextel customers onto his system that he's barely got time to sleep. If you catch him snoozing, nudge him.

If you get a chance, look up Bob Cook of Fresno Mobile Radio. His company is the lead appellant in the 800MHz auction appeal before the court. He's a smart businessman and a heck of a nice guy. His wife, Peggy, is fun too, if you get her away from the slot machines. Bob's quietly committed to the idea that nobody ever won by tossing in the towel. If you knew his dad Don, you'd understand that the apple didn't fall far from the tree.

If you want the straight skinny on 220MHz systems from one of the premier operators, look up Bob Fay of Police Emergency Radio Systems. Fay is going great guns, planning to take over the world of 220MHz, one FCC decision at a time. He is savvy about his product and his chances.

Looking to find out what's going on in towers? Drop by Jim Fryer's booth and have a chat. If it's going up, coming down, being sold or being bought, Jim knows about it. Jim can help any tower owner or manager improve business. (Also, his assistant, Mary, does a heck of a rendition of "These Boots Were Made for Walking.")

Look for guys from UTC* and FIT* emerging from the shadows. They're usually there taking in the sights and opinions from the operators that fill the floor. These groups, like so many, come to IWCE to feel the pulse of the industry and find out what's working and what isn't.

Don't forget to talk to Don Bishop and Dave Keckler from the *MRT* staff. This deadpan duo will corner you into a discussion about the direction the industry is headed. They really want an answer, too; it seems "to Hell in a handbasket" just doesn't satisfy everyone. (Anyway, *MRT* publisher Mercy Contreras always looks a little piqued when I cuss around her.)

Slithering around the place will be lawyers like yours truly. We get to pontificate and provide great insights into the vast abyss we call the FCC. Look for the usual suspects: Russell Fox, Curt Brown, Marjorie Connor, Liz Sachs, Kate Kaercher and Alan Tillis. We'd all like to shake your hand (in a race to see which one gets your watch).

Then there are the parties. Free booze and free food—if you listen to your host for an hour or so. This year it's SBT, Trident Micro Systems, Transcrypt/E.F. Johnson and Kenwood Communications all having get-togethers.

If you're an "issues" guy instead of a gamble-and-get-blasted type, there's plenty to go around: the emergence of Flex paging, tower-siting issues, incumbent operator rights, the intentions of the new commissioners, electronic filing, auction software issues, global trunking, the 800MHz auction appeal, 450MHz trunking, utility companies' entrance into the commercial radio market, the Telecommunications Development Fund (which may now be ready for business), reseller rights and more. And for your special entertainment value, you can actually *speak* with the people who work for the FCC and Congress.

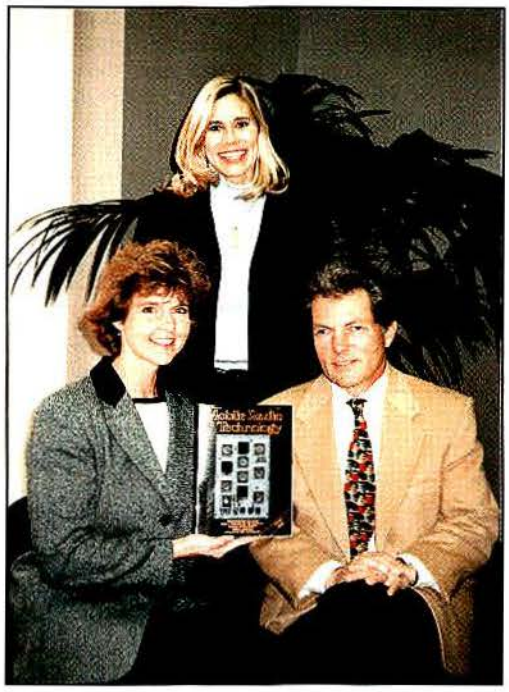
Oh, yes ... if you want to discuss cocktail waitresses, whether to hit a soft 14 when the dealer's showing a 10, how many yards you can get from an 8-iron, the emerging questions about Siegfried and Roy, blended vs. unblended scotch and St. Louis Cardinal baseball ...

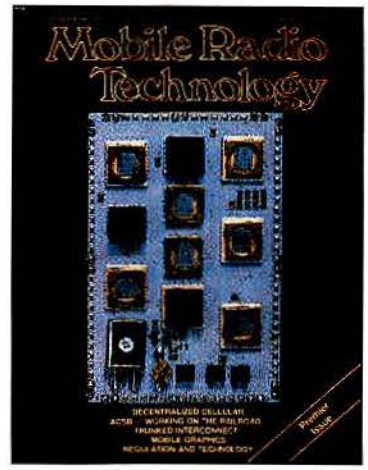
... I'll be there, too.

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*SBT: Small Business in Telecommunications.
*APCO: Association of Public-Safety Communications Officials–International.
*UTC, the Telecommunications Association, addresses the communications needs of public and private utilities and associated businesses.
*FIT: Forest Industrial Telecommunications.

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New-Tronics sets its sights on land mobile market share

Despite his observation that the land mobile radio business has been flat, New-Tronics Antenna's marketing manager, Larry Guyton, sees "growth potential without bound" for the Mineral Wells, TX, company's Hustler brand antennas. Where does growth come from? "We're taking business from other companies, such as Celwave, Decibel Products, Antenex and Maxrad," he said.

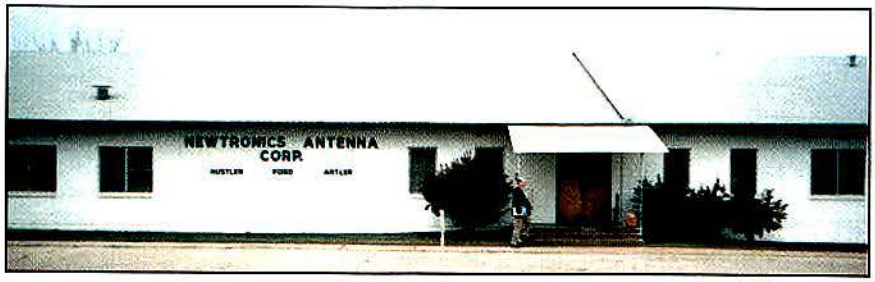
With low overhead, plenty of capacity for expansion, no debt and an established brand, New-Tronics is poised to compete at the customer level as well as to offer private label manufacturing. Capturing market share, Guyton explained, is partly a matter "of being there when someone drops the ball. If they do that, I'll get the business. I take pride in my own reliability as well as that of Hustler. Also, there still are a lot of personal relationships in the antenna business. I like that."

Land mobile accounts for 60% of the company's business and 70% of its profit. CB is a small portion, but along with AM radio antennas, "it's where we began, so we like to stay in it," Guyton said.

In 1997, New-Tronics sold its PCS antenna line to Racal, which previously had licensed the rights to its antenna designs to New-Tronics. Company owner and president Clyde Ford said that the profitability of the PCS antenna line was not unnoticed by Racal. "They decided that 100% of the profits would be better than royalty payments, so they bought back the line."

Ford, with a background as an executive with Stromberg-Carlson and Radio Shack, formed Ford Manufacturing Co. in Mineral Wells in 1975 to make private label CB antennas for Midland International and others. He established New-Tronics Antenna Corp. in 1985 to purchase Hustler Inc. and the Hustler antenna line. (Until 1968, Hustler Inc.'s name had been Newtronics Corp.) Ford had seen the company advertised for sale in the *Wall Street Journal*.

"'Hustler' was a better name before the magazine came out," Ford mused. Guyton observed that, *Hustler* magazine aside, "Hustler" is a good name, "although it has *some* stigma from CB antennas. On the other hand, many commercial customers happen to be radio amateurs, and the good-



New-Tronics Antenna has its offices and a portion of its manufacturing and warehousing facilities in Mineral Wells, TX.

The New-Tronics timeline:

1957: Newtronics Corp. is established as an AM mobile antenna-making subsidiary of Automatic Radio, which supplied car radios to the auto industry.

1961: Newtronics Corp. begins using "Hustler" as a trademark. In the early '60s, the company introduces amateur radio antennas. By the late '60s, CB antennas are introduced.

1978: Newtronics Corp. changes its name to Hustler Inc.

1979: Hustler Inc. moves from Cleveland to Kissimmee, FL. Company sales peak in excess of $30 million with the CB boom of the '70s. In the '80s, land mobile antennas are introduced.

1985: Clyde Ford forms New-Tronics Antenna Corp. to buy Hustler Inc. and relocates the company to Mineral Wells, TX, where his Ford Manufacturing Co. had been in the antenna business since its founding in 1975. The transaction reestablishes "New-Tronics" as the company name and continues "Hustler" as a trademark.

1988: New-Tronics moves about half of its assembly operations to Comales, Tampico, Mexico, where most of the mobile antennas are assembled.

1992: New-Tronics introduces its Spirit line of omnidirectional fiberglass base station antennas.

1995: Racal licenses New-Tronics to manufacture PCS antennas using Racal's designs.

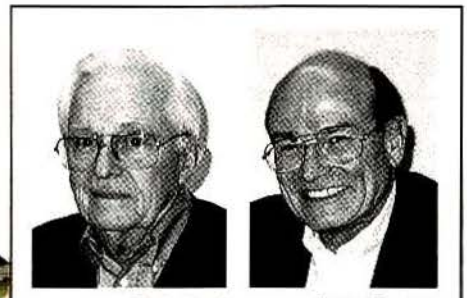
1997: Racal buys out New-Tronics' license agreement and establishes its own manufacturing plant in Mineral Wells. New-Tronics introduces new NMO-mount VHF and UHF mobile antennas.



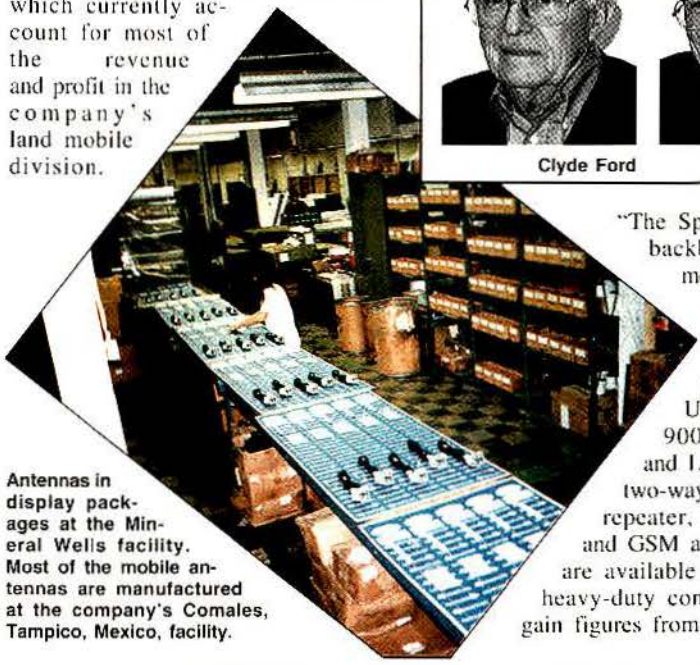
Circle (80) on Fast Fact Card

will from Hustler's amateur radio antennas has a positive influence," he said.

In 1992, New-Tronics began manufacturing its Spirit line of omnidirectional fiberglass base station antennas, which currently account for most of the revenue and profit in the company's land mobile division.



Clyde Ford Larry Guyton



Antennas in display packages at the Mineral Wells facility. Most of the mobile antennas are manufactured at the company's Comales, Tampico, Mexico, facility.

"The Spirit series is the backbone of our domestic land mobile market," Guyton said. The antennas come in VHF, UHF, 800/900MHz, 1.2GHz and 1.4GHz models for two-way radio, trunking, repeater, cellular, paging and GSM applications. They are available in standard and heavy-duty configurations with gain figures from unity to 12dBd.

"Much of New-Tronics' future success will stem from the sales of Spirit products," he said.

Guyton said that New-Tronics has introduced new UHF and VHF mobile antennas based on the NMO mount. The new models, LMB and LMG, are expected to generate sales equal to 30% of the base station antenna sales.

"They weigh more, they're heavier-duty, the look better and they are less expensive" than competing antennas, Guyton said.

On a worldwide basis, the G-6 UHF omnidirectional and G-7 VHF omnidirectional base station antennas are the company's best-sellers.

The company soon will introduce new cellular and lowband VHF antennas. *Lowband* VHF antennas? Why? "We're getting calls for lowband VHF antennas," Guyton said. "Apparently, the other frequencies are filling up, and people are taking another look at lowband." Just in time for sunspots and the skip interference they bring.

"New-Tronics has a billion-dollar potential," Guyton said. "It could be the next Decibel."

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RedCell prepares to supply rechargeable batteries, chargers, accessories for various applications

Quietly, a new North American company has spent the past two years readying a line of rechargeable batteries, battery chargers and accessories for various applications, including two-way radio transceivers. The company, RedCell, based in Calgary, Alberta, Canada, debuted its products in January.

"People looking for two-way batteries want a 'cheap fuel source,'" said Brent Meikle, the company's vice president of product development. "That might involve premium, long-life batteries for companies that use battery management, or it might involve a low-price 'value battery' for companies too small to have a battery-care program. We offer both types of batteries, and both are priced below the competition."

Unlike wireless phones and camcorders, which are consumer products, everyone who buys a two-way radio is spending money on operations, Meikle observed. In his opinion, the two-way radio battery market has attracted niche-market manufacturing with high prices.

"Yet, crack open a two-way radio battery, and you find the same thing as in cellular phone or video camera batteries: three or four D-cell or C-cell batteries. What RedCell is doing is developing a system for mass merchandisers, which can bring down the cost of operating two-way radios," Meikle said.

RedCell uses welded flexport technology to cut costs. The method uses a flexible circuit board that allows direct welding and riveting to the battery pack, which reduces labor costs by 70%. Meikle listed the other advantages: "Less soldering. Eliminates wires, straps and harnesses. You get a cleaner battery that won't short-circuit. No crushed wires or rattling from loose components and bad solder joints. It improves the battery and makes it less expensive."



Meikle

Meikle said users, dealers and distributors all have different requirements from a battery supplier.

"Users should talk with their dealer or distributor about their two-way radio working environment, battery-charging requirements, warranty and customer service satisfaction, and overall battery program cost, and then ask for a recommendation for reducing costs. If the dealer can't help, then contact the original manufacturer of the battery," Meikle said.

"Dealers should evaluate whether their manufacturers are supporting them in what they offer their customers. If they're not satisfied, or if they're curious, I'd like them to contact us to allow us to send some products or programs to evaluate. We want distributors to contact us and try our product, and the see the pricing and level of service they can get," Meikle said. "We look at two-way as—outside of cellular—the only service-oriented product we will manufacture. We see a strong demand for two-way radio batteries into the next century." To support two-way radio batteries, RedCell offers more than 200 types, as well as one-bay and six-bay charging systems that will charge NiCd, NiMH and Li-ion batteries.

RedCell is at #1, 115 - 28 Street SE, Calgary, Alberta T2A 4K4, Canada; Tel. 403-207-5612; *www.redcell.com*.

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News notes

Transcrypt International, Lincoln, NE, is set to license its LTR-Net protocol to **SmartLink Development,** Raleigh, NC, to use with its multiprotocol trunking and network systems. **Jeff Fuller,** Transcrypt's chief executive, said SmartLink's use of the protocol will help to establish it "as the *de facto* standard in enhanced SMR trunking protocols." Transcrypt's vice president of engineering and marketing, **Joel Young,** added that "LTR-Net is the only protocol which offers complete over-the-air compatibility with existing LTR systems." Speaking of another matter, **Bob Wise,** SmartLink's manager of international sales, said the company has contracted Midland Mobile Radio, Theale, Berkshire, England, to represent its interests outside the United States and Canada. "LTR-Net has unlimited potential in the international marketplace," added SmartLink executive vice president for marketing **Craig Johnson.**


Fuller


Wise


McEwan

American TriTech, San Diego, has sold one of its "VisiCAD for Ambulance" computer-aided dispatch systems to Metro Toronto (Canada) EMS. The system is "specifically designed for EMS professionals," said **Sean McEwan,** company chairman. **Ron Kelusky,** director of EMS operations for Metro Toronto EMS, said "The program's reliability, scaleability and detailed management reports will allow us to substantially increase our operational efficiencies, improve response times and seamlessly integrate with other emergency service agencies." **Rick Hune,** manager at **Signal Communications Service's** Miami branch, said the Fort Lauderdale, FL-based company has moved his branch office to 6916 NW 72nd Ave. The office serves Dade and Monroe counties.


Kelusky


Hune

Bill Ford, computer specialist and project manager for the city of Vicksburg, MS, said that the city's new single-site, five-channel **Motorola** Astro Smartzone trunked two-way radio system allows agencies to communicate with either digital or analog equipment. Vicksburg

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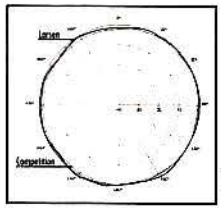
Wireless Communications Products and Systems

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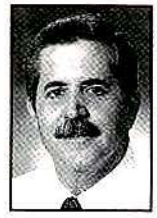
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has the first such Astro single-site system. It was dedicated on Jan. 6, 1998. **Ron Elwell,** vice president of Stratford, CT-based **Dictaphone,** said that the **Capital Area Planning Council** (CAPCO) has purchased $1.2 million worth of ProLog digital recording systems for public safety answering points (PSAPs) in 10 Texas counties. "Most of the 36 PSAPs had been using older reel-to-reel equipment," said **Joanna Oliver,** CAPCO's public education and training manager. ... **Robert J. Shiver,** chairman of **Intek Diversified,** Princeton, NJ, said that the company's **RoameR One** subsidiary expects to acquire the assets of 220MHz service provider **Wireless Plus,** Hayward, CA. Reasons given for the purchase include Wireless Plus' coverage and capacity in San Francisco.


Elwell

Maxrad, Hanover Park, IL, has added three manufacturers' representatives in the Midwest: **Advanced/PLM Sales & Marketing,** Oak Park, IL; **Capitol Electronics,** Plainfield, IN; and **W.E. Price & Company,** Houghton Lake and Waterford, MI. "All three companies bring over a 10-year record of service in the wireless communications business," said **Steve Rahn,** Maxrad's vice president of sales and marketing. ... **TwitCo Distributing,** New Ipswich, NH (800-899-8948), offers a new dealer price list with new products and "aggressive dealer discounts." ... **TekNow,** Phoenix, has formed co-marketing agreements with Parsippany, NJ-based **Dialogic** and Minnetonka, MN-based **Digi International.** "TekNow can focus on developing the most advanced messaging software available while relying on its vendor partners to deliver the finest hardware solutions in the industry," said TekNow president **Ralph Tomeoni.**


Tomeoni

U.S. Sen. John McCain (R-AZ), chairman of the Senate Commerce, Science and Transportation Committee, is drafting legislation with language that may help wireless communications carriers to overcome local-government opposition to antenna tower construction. Justification for federal intervention may be based on a perceived need to provide uniform wireless emergency 9-1-1 service. "Because ubiquitous wireless service depends on wireless carriers' ability to install necessary transmitting towers, this legislation will also seek to provide a process that can be used for resolving local tower siting issues," a description of the legislation issued by McCain's office reads. ... **Motorola's** Customer Owned Messaging, a part of the company's Paging Products Group, Boynton Beach, FL, will develop new applications together with **JTECH,** Boca Raton, FL, for business offices, retail stores, manufacturing facilities, restaurants and auto dealerships. "This relationship will allow us to integrate on-premises pager products into new applications and give customers a total turnkey package," said **Jeff Graham Sr.,** JTECH's chief executive. ... **SourceOne Wireless,** Chicago, will market interactive paging service provided by **RAM Mobile Data.** SourceOne brings a customer base of 400,000; RAM is bolstering its nationwide coverage. RAM vice president **Thomas Eberle** said his company's network "will offer interactive paging with coverage comparable to one-way paging across the United States."


McCain


Graham


Eberle


Denaro

Motorola and **Nissan** are fitting luxury sedans with "telematics," which use wireless voice and data to provide drivers and passengers with location-specific security, information, convenience and entertainment services

from a central service center. **Robert Denaro** is vice president of Motorola's newly formed Telematics Information Systems Business. ... **Digital Voice Systems,** Burlington, MA, has licensed its improved multiband excitation (IMBE) voice compression software to **Racal Communications,** Rockville, MD, for use with Project 25 mobile communications equipment. ... **Orbcomm,** Dulles, VA, was set to begin commercial service in mid-April with an initial eight satellites (of a planned 36) relaying communications from the **Magellan** GSC 100 portable text-messaging unit. The units communicate among themselves, as well as to and from any Internet email address.

Lee Ellison, senior vice president at **Glenayre,** Charlotte, NC, said Glenayre and **Unicom China Paging** have launched the third phase of Unicom's nationwide paging network in China. "This is one of Glenayre's largest projects in China," he said. ... **William L. Collins III,** president of **Metrocall,** Alexandria, VA, said his company merged with **ProNet** on Dec. 31, 1997, creating what he described as "the country's second largest wireless messaging company." ... **Joseph T. Gorman,** chairman of **TRW,** Cleveland, said his company is acquiring 7% ownership of **ICO Communications,** that TRW and ICO will cross-license each other's patents, and that they are dismissing their patent litigation against one another. The companies expect to implement a medium-earth-orbit satellite communications system.


Collins


Gorman

Former Apollo 12 astronaut **Capt. James A. Lovell Jr.,** speaking on behalf of Sunnyvale, CA-based **Ashtech's** board of directors, said the pending merger of Ashtech with **Magellan** is "a shining example of how business can help us achieve the promise that space technology offers for enhancing our lives." Ashtech develops and manufactures Global Positioning System (GPS) technology; San Dimas, CA-based Magellan, a subsidiary of **Orbital Sciences,** makes GPS consumer products and satellite communications equipment.

PageMart Wireless, Dallas, has plans to support paging functionality for Windows CE devices. "Users have told us they want to carry fewer devices, with advanced, integrated features such as wireless email, sender ID and automatic schedule updates," said company chief executive **John D. Beletic.** ... **Signal One,** Chattanooga, TN, has an exclusive agreement with **Pilot,** Knoxville, TN, to build communications towers on Pilot's land and to co-locate antennas on Pilot's signs and travel center buildings in 36 states at 103 interchange locations on interstate highways. Signal One's president is **G. Larry Wells.**

The Bristol, England, office of investment capital group **3i** has invested $3.5 million in Bristol-based

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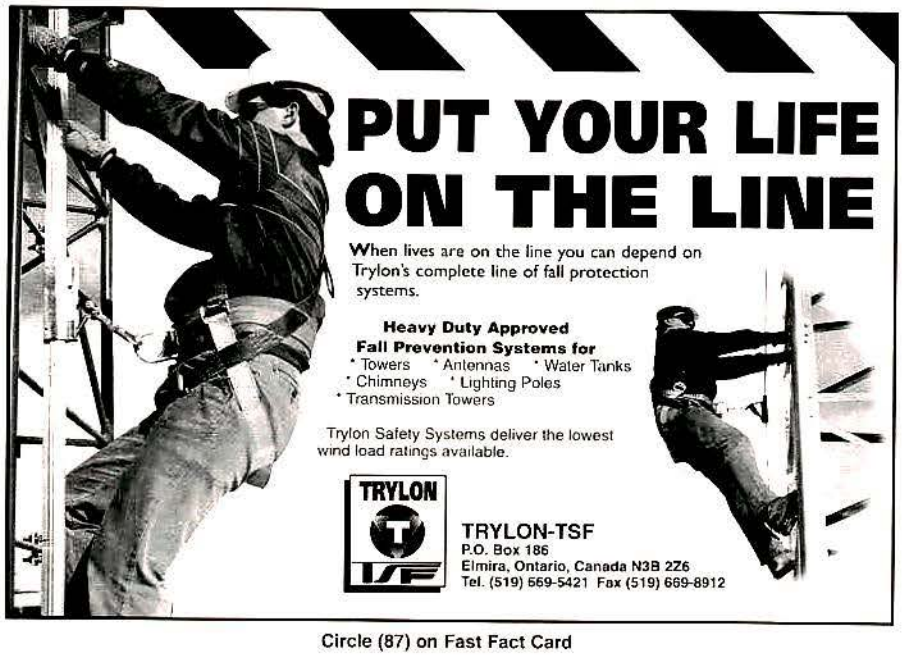
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Wireless Systems International, which intends to manufacture high-linearity RF amplifiers for mobile telephony, paging, digital terrestrial and satellite broadcasting. "The worldwide market for base station amplifiers is worth $950 million per annum and is growing at 20% per annum," said Wireless Systems' managing director **Simon Jones.** ...

Spectrian, another manufacturer of ultralinear base station amplifiers, has signed a five-year lease on a 20,000-square-foot manufacturing and engineering facility in Stanford Ranch Industrial Park, Stanford, CA. "We expect to fill 60 positions at the new facility," said **Garrett Garrettson,** president of the Sunnyvale, CA-based company. ... Another Sunnyvale company with a product intended to reduce dropped calls, **ArgoSystems,** is conducting trials of its adaptive beamforming antenna system at Bell Atlantic Mobile cell sites in New York. "We were able to show improvements of upwards of 40dB," said **Bob Hockett,** general manager of the company's Commercial Communications Division.



Circle (86) on Fast Fact Card



Circle (87) on Fast Fact Card

Dataradio Group acquires RNet line

The Dataradio Group of companies has purchased the RNet synthesized fixed data products from Motorola. Dataradio, Atlanta, had previously been the sole distributor for the RNet products and will now consolidate all distribution for the group's fixed products, including RNet under Johnson Data Telemetry (JDT), Burnsville, MN, purchased last year.

The addition of the RNet 450S and 9600S will complement the JDT synthesized product offering, which emphasizes high-tier international ETSI specifications, remote diagnostic and power conservation feature sets. Both the JDT and RNet products adopted the Dataradio Interoperability Standard (DIOS), which assures pin-for-pin and over-the-air compatibility.

"In anticipation of the acquisition, JDT recently introduced a new RNet-style JSLM product line, which will bear the RNet brand," said Guy Kelnhofer, JDT chief operating officer. "The JSLM is a second-generation RNet product to address the half-channel requirements of FCC refarming. It has the same form factory and pin-outs as the RNet 450 SLMS radio and expands the frequency offering to VHF in addition to UHF. This is good news to RNet customers who need a VHF product."

Washington awards Transcrypt with $1.3 million contract

The Washington State Department of Transportation has agreed to purchase APCO trunking equipment worth $1.3 million. The purchase agreement calls for Transcrypt, Lincoln, NE, to provide WSDOT with Summit mobile radios. The radios will be incorporated into Washington's statewide APCO trunked radio system.

UniSite relocates to Florida

UniSite has moved its corporate headquarters from Richardson, TX, to Tampa, FL. The new address is: UniSite, 3450 Buschwood Park Drive, Suite 250, Tampa, FL 33618.

Readers' choice

Of all the new products and services in the August 1997 issue, the one reprinted here generated the most reader requests for additional information. If you missed it the first time, here is your opportunity to acquire more information on it. Just circle the corresponding Fast Fact Card number on the card found in the back of this issue and mail the card to us.

Hand-held radios are programmable by channel



Uniden Private Radio Communications' hand-held portable radios (SPH255 and SPU554) bring many of the features and capabilities of the public safety radios to the business and industry customer. They are programmable by the channel for 12.5kHz and 15kHz narrowband or 25kHz and 30kHz wideband operation. The radios have 99 channels, a backlit alphanumeric LCD and a DTMF keypad. The programmable feature allows compatibility with mixed narrowband and wideband systems. Both models are compliant with a wide range of Mil-std-810E tests, and an intrinsically safe option is available.

Circle (500) on Fast Fact Card

Antenna offers pattern consistency

An omnidirectional array antenna from **TX RX Systems** covers the entire 806MHz–840MHz band. Model 101-90-08-0-01 is a highly versatile antenna featuring exceptional bandwidth and pattern consistency, as well as 8dBd gain, 10° vertical beamwidth and 1,000W power handling capability. Its integrally welded radiating surface and unique air line feed system minimize unwanted noise and intermodulation products.

Circle (401) on Fast Fact Card

Surge protectors use gas-tube technology



Citel's line of coaxial surge protectors for microwaves, radios, antennas, GPS and satellite systems are suitable for the cellular industry. They provide a fast-acting protection against lightning surges and electrical transients. Coaxial surge suppressors use a gas-tube technology that makes them usable for broadband applications. Many connectors are offered: N, BNC, TNC, SMA, 7/16. The P8AX coaxial protectors are available for any power from 1W to 1,000W and any frequency from dc to 10GHz. They feature low VSWR and insertion loss. Grounding can be done done through an external ground screw or through a bulkhead mount. Their small size makes them easy to install, and they mount as a cable assembly or through the chassis of the equipment to be protected.

Circle (402) on Fast Fact Card

Recorder expands channels, message storage capacity

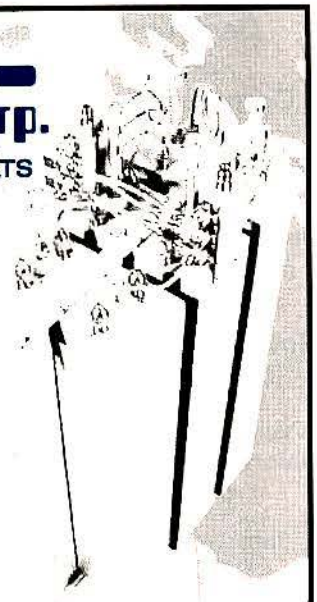
Racal Recorders has enhanced its Wordnet digital communications recorder for message archiving and replay in call centers and law enforcement and emergency services environments. The voice logger includes a 50% increase in the number of recording channels (from 64 to 96), providing Wordnet users with a range of between 8 and 96 channels so that fewer recorders are required for the same number of telephone lines. This reduces the footprint of the suite of recorders required to monitor agent positions and cuts the capital cost of logging calls. It includes a doubling of instant message storage capacity from 600 to 1,200 channel hours and a tripling of archival storage capacity from 660 to 1,980 hours. The recorder digitizes all incoming messages and records them for the short-term on hard disk, then archives all messages onto secure, tamper-proof removable DAT media. The recorder—which can be used as a stand-alone system or within a network—provides instant message access, fast database search and replay. The recorder allows more than one operator to simultaneously record and replay messages without interrupting the recording process.

Circle (403) on Fast Fact Card

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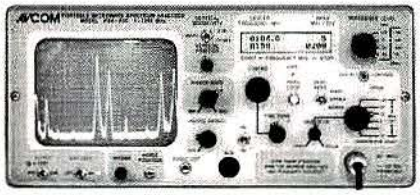


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AVCOM's newest Portable Microwave Spectrum Analyzer, model **PSA-65C**, has a frequency range from less than 1 MHz to 1250 MHz with a sensitivity greater than -95 dBm at narrow spans, for the amazing price of $ 2930.

AVCOM's new **PSA-65C** is a low cost general purpose spectrum analyzer that's loaded with standard features including FM audio demodulator, AM detector and digital frequency lock. The **PSA-65C** covers frequencies thru 1250 MHz in one sweep. The **PSA-65C** is ideally suited for 2-way radio, cellular, cable, satellite, LAN, surveillance, educational, production and R&D work. Options include new 1250 MHz frequency extenders, BNG-1000A tracking (noise) generator, log periodic antennas, carrying case (AVSAC), and more.

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Circle (67) on Fast Fact Card

New products

Power supplies offer precision measurements



Hewlett-Packard's four new dc power supplies are designed to reduce test-system development time and to provide precision measurements. In addition, HP introduces an enhanced and more compact version of its 40W power supply, the HP6612C. The dc power supplies include the HP6611C, HP6613C, HP6614C and HP6631B. The power supplies provide current measurement down to the microamp level. There is no need to configure external shunts, relays and digital multimeters to make measurements. A key feature of the power supplies is the testing throughput. The new products provide high-speed programming with under four-millisecond response time. A two-quadrant output source gives six-millisecond output uptime and downtime.

Circle (404) on Fast Fact Card

Mobile phone tester offers features for service sites, repair depots

The **Wavetek** 4100S is a compact, portable mobile phone tester that offers the features required for service sites and repair depots. Features include asynchronous mode, burst edge failure indicator and remote control using RS-232. The asynchronous mode enables the user to tune or align the mobile phone that is operating in a test mode and transmitting a continuous GMSK signal. The phone can be adjusted to meet GSM specifications with the measurements displayed. With the remote control capability, the tester can be controlled via the PC using SCPI command set. This allows special test routines or interactive programs to be used with the PC. This feature allows the service site to carry out trend analysis, warranty claims and record statistics for each phone. Programs can be written for the PC, providing customized test routines for the tester.

Circle (405) on Fast Fact Card

Counter tests radios anywhere



Optoelectronics' Techtoyz Micro Counter is housed in a pager-style case. The counter clips to a belt or will fit in a pocket. With a frequency range of 10MHz to 1.2GHz, the Micro Counter can lock onto a 5W UHF radio from as far away as 125 feet using the optional TMC100 rubber duck antenna. With an initial accuracy of 1ppm and a sensitivity level of <5mV, the Micro Counter is suitable for testing radios in the shop or in the field. Three selectable gate times are for increased resolution of the frequencies captured. The counter has four modes of operation: normal, filter, recall and digital auto capture.

Circle (407) on Fast Fact Card

Photovoltaic power system receives UL listing

Solar Electric Specialties' MAPPS (modular autonomous photovoltaic power supply) are prepackaged stand-alone solar electric power systems, engineered to support a wide variety of remote power requirements. The SES MAPPS UL listing ensures that the system's design and components meet safety standards. Features of the power supply include photovoltaic modules, solar/cell sealed batteries, a charge/load system controller and a balance of system components. The modules are FM approved, and the batteries are maintenance-free. All components are suitable for use in harsh environments.

Circle (406) on Fast Fact Card

Paging system receives longer pager IDs, offers chaining paging

Hark Systems' TAP 2000 paging system product line now allows as many as 24 alpha paging inputs using one high-speed computer port in the paging terminal. New standard features to the TAP 2000 include extended capability to receive longer pager IDs of as many as 16 digits and a chaining paging feature. With these features, the product line complies with the paging market's use of longer pager IDs. The chaining pager feature allows alpha messages of as many as 4,000 characters. Both features have been added at no additional cost for the basic system.

Circle (408) on Fast Fact Card

Field strength meter tests signal coverage



Model R-506 field strength meter from **Z Technology** is a precision measurement instrument for RF testing of signal coverage. It is portable, battery-operated and fully synthesized. The product covers 5MHz to 1,000MHz and allows tuning to 1kHz frequency steps. The instrument has a 100dB dynamic range and measures signals from 0.32mV up to 32mV. It has a 50Ω input impedance. Power measurement accuracy is guaranteed to within 62dB and is traceable to NIST. The front panel provides several operating modes, including 40-frequency user-defined memory recall capability, self-contained resident data logging for PC independent data collection, easy TV channel step tuning, and a function control for such uses as monitoring battery voltage, optimizing internal measurement parameters and setting data collection acquisition speeds. From the front panel, an operator can directly read signal levels in dBmV, dBm and dBmV/meter. The later readout mode is used in conjunction with calibrated antennas to measure parameters and setting data collection acquisition speeds.

Circle (409) on Fast Fact Card

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Circle (71) on Fast Fact Card

New products

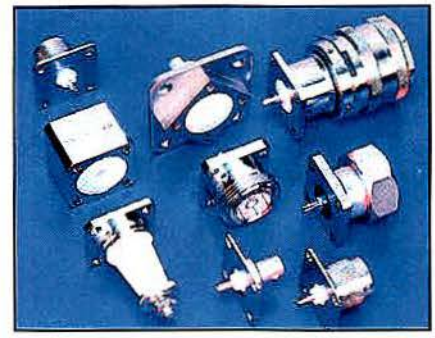
800MHz portables operate on several trunking formats



Portable radios from **Maxon America,** the MAX-8D and EP-4800, offer many built-in features. The MAX-8D full duplex, half-duplex LTR/ESAS trunking portable radio provides trunked communication in the 800MHz range. This model offers as many as 100 systems and 100 groups selections. With a one-touch phone mode and four-line alphanumeric menu driven LCD, the MAX-8D provides increased user flexibility. The model also has a programmable phone book with memory storage of as many as 60 names and phone numbers. The radio features dispatch capability, ESAS roaming, audio companding and busy system queuing. The adjustable antenna can be raised or lowered for better reception. The EP-4800 model features the dual protocol of as many as 16 systems selectable with as many as 16 groups per system with EDACS or nine areas by nine groups with GE-MARC. Operating at 2W RF power, this portable functions in both conventional and trunked modes, each with talkaround.

Circle (410) on Fast Fact Card

Connectors feature universal interface, adapter



A universal, quick-change panel receptacle interface and adapter block from **Tru-Connector** lets users change connectors at any time by removing four screws. It also enables them to interconnect any series of RF coaxial connectors. Quick-change RF connectors incorporate a consistent QC end and are available in 7/16, BNC, C, HN, LC, LC-large, LT, N, QDS, SC, SMA, TNC, UHF, LC-HV, LC-POL, SQS and 7/8" and 1 5/8"-50 EIA types. The connectors feature a 1 1/4" square panel mount base plate and an adapter block that combines all connector types and solves gender mating problems. Designed for use with wattmeters and other high-power test and monitoring equipment, the connectors let users perform on-site connector changes without affecting the consistency of test results. These versatile connectors are constructed from nickel-plated brass with a Teflon insulator and silver-plated beryllium-copper contacts.

Circle (412) on Fast Fact Card

CD-ROM features carrier profiles

Wireless ScoreKeeper United States from **Strategis Group** is a next-generation market analysis tool that can consolidate the volume of data in the wireless industry. Wireless ScoreKeeper is a map-based CD-ROM that lets the user easily navigate through an extensive database of demographic, economic and carrier profile information by geographic area. A point and click on a map enables the user to access cellular and PCS information including licensed carriers by footprint area; demographic maps and tables at MSA/RSA, MTA/BTA and county levels; nationwide, regional, MTA/BTA, MSA/RSA, state and county boundary areas; detailed carrier abstracts; licensee points of contact/information; and market ownership.

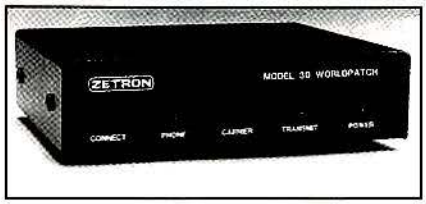
Circle (411) on Fast Fact Card

Cooling unit offers flexible configuration

Liebert's Mini-mate2 provides precision cooling and humidity control of small spaces. The cooling system, available in 1-ton or 1.5-ton sizes, is installed above a dropped ceiling, saving floorspace for protected equipment. The system also offers the flexibility of configuration options such as ducting, various reheat options, freecooling, both 50Hz and 60Hz voltage options and other features to allow the system to be tailored to the needs of your applications. Mini-mate2 provides features such as high sensible cooling capacity, rugged design for year-round, reliable operation, two-speed fan, microprocessor controls, local service and support. All components are easily accessible for service.

Circle (413) on Fast Fact Card

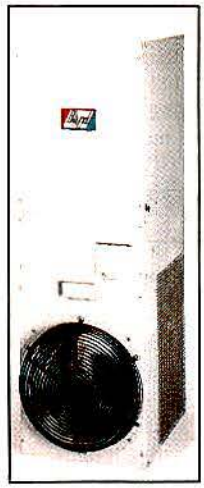
Telephone interconnect offers selective calling for small apps



Zetron's versatile telephone interconnect has selective-calling formats and is suitable for smaller, customer-owned applications. The model 30 Worldpatch is a compact, one-line phone patch for business facilities such as agriculture, construction, manufacturing and delivery companies. It is now available with a built-in encoder for two-tone and DTMF selective signaling. This means that a phone party can dial into the Worldpatch, overdial an extra sequence and reach a specific radio without having to alert every radio on the system. Owners of previous versions of this telephone interconnect can obtain an ugrade kit and add the selective-calling feature in the field. The model 30 can interface a telephone line to either a base station (simplex) or repeater (half duplex). Base station installations are enhanced with an available digital-voice delay. The model 30 can also support PBX installations.

Circle (414) on Fast Fact Card

Commercial air conditioner cools cabinets, enclosures



The Com-tec cabinet air conditioner from **Bard Manufacturing** is for smaller-cabinet, micro-cell and enclosure applications. The unit is a commercial grade self-contained air conditioner built to withstand operation from 220°F to 125°F. The unit's 19" × 61" footprint produces 25,000 BTUs of reliable factory-tested cooling. All installation and service access are from front side. Features include a built-in two-speed condenser fan motor, circuit breaker, high and low pressure switches, low ambient control, compressor anti-cycle relay, corrosion-resistant, pre-painted steel cabinet and 230V and 208V power supply. Options include factory built-in electric heat, economizer and Bard MC91 series or TEC20 lead-lag controller for operation of two units. All units are CUL and UL listed.

Circle (417) on Fast Fact Card

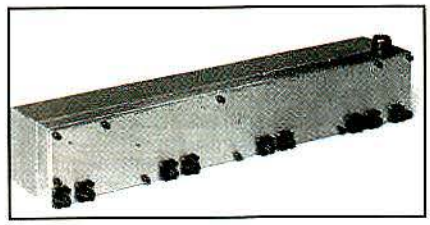
Transmitter programmable for PCS/PCN frequencies

MLJ's enhanced in-building test transmitter, Sparrow generates a clean CW output signal up to 1W and is programmable over the PCS or PCN frequency spectrum. Small and lightweight, the portable Sparrow transmitter is inconspicuously deployed. Its rugged structure allows it to withstand rough handling. Several Sparrow units can be mounted on the ceiling or tripods throughout an indoor area with a single receiver gathering the data. The transmitter is suitable for all in-door wireless and microcell planning, and it allows inter-floor propagation to be measured and evaluated. The transmitter is programmed using a detachable hand-held terminal that plugs into the RF module. It also includes an ac adapter and can operate using optional rechargeable batteries that provide seven to nine hours of RF output at full power.

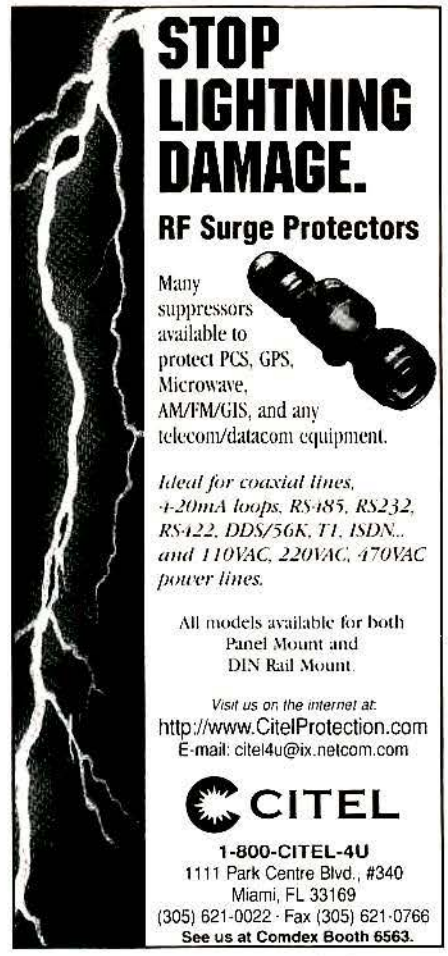
Circle (415) on Fast Fact Card

Switchable divider/combiner supports four amplifiers

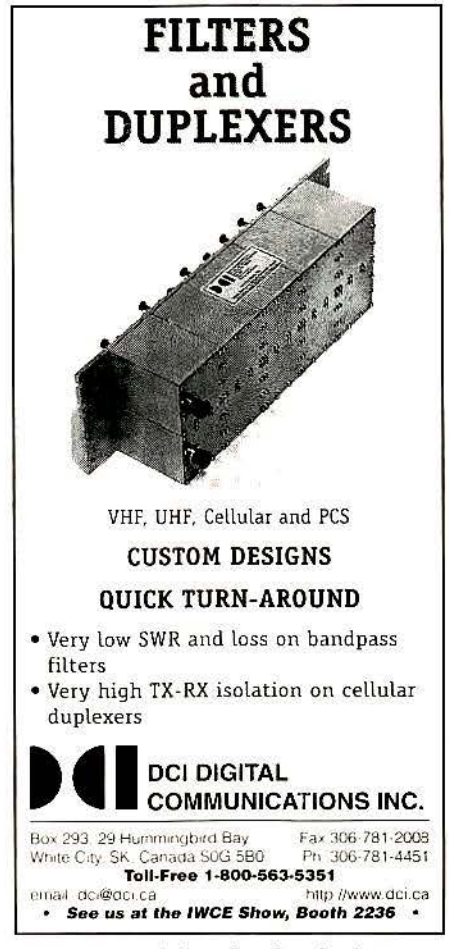
Narda's divider/power combiner contains a divider that allows one low-level signal to be split into four amplifier inputs. The combiner has an RF output of as much as 250W CW. The divider/combiner was designed for cellular and PCS transmitter applications. Within these frequency bands of operation, the maximum output VSWR—for any combination of as many as four amplified outputs—is 1.4:1 with a maximum combined insertion loss of 0.5dB (typically, 0.35dB).



Circle (416) on Fast Fact Card



Circle (88) on Fast Fact Card



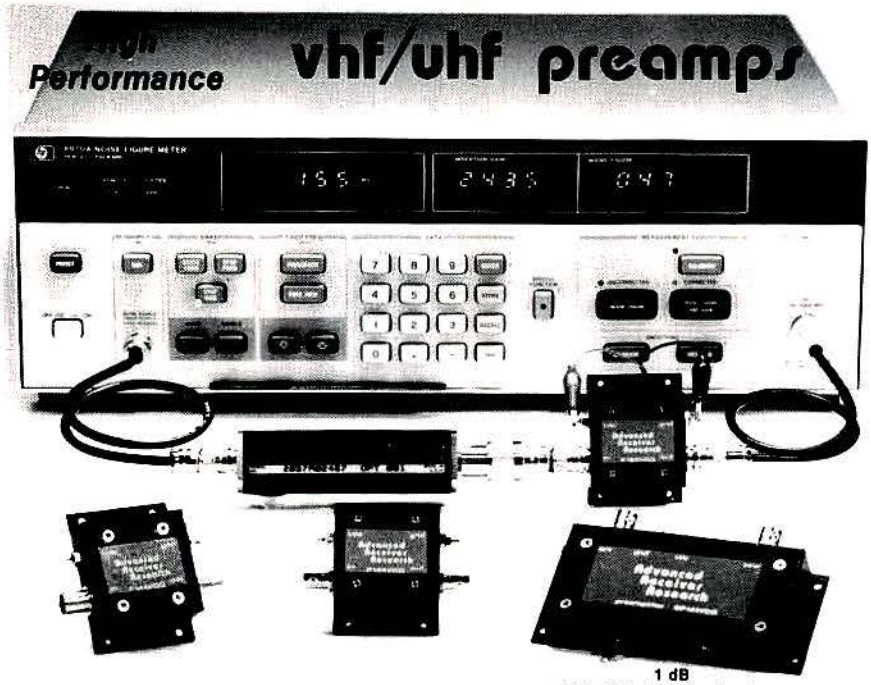
Circle (89) on Fast Fact Card

New products

Software manages ad funds for two-way radio dealers

Zapotec Software's co-op management software is for the retail industry. The CO-OP EASY suite of application software is a complete, co-op promotional funds management program. The suite of application software enables any size retailer or distributor to effectively manage, track and claim co-op promotional funds offered by manufacturers. The product suite includes CO-OP EASY PRO, CO-OP EASY PRO PLUS and CO-OP EASY PROMAX. Co-op is a marketing strategy that promotes the manufacturer's brand-name products on the local retail level. Co-op is a funding source for retailers, provided they meet the requirements of the manufacturers, and it can increase marketing budget drastically.

Circle (418) on Fast Fact Card



Receive only	Freq. Ranges (MHz)	N.F. (dB)	Gain (dB)	1 dB Comp. (dBm)	Device Type	Price
P30VD, P35VD, P40VD, P45VD	30-35, 35-40, 40-45, 45-50	<1.3	15	0	DGFET	$ 44.95
P30VDG, P35VDG, P40VDG, P45VDG	30-35, 35-40, 40-45, 45-50	<0.5	26	+12	GaAsFET	$109.95
P150VD, P160VD, P170VD	150-160, 160-170, 170-180	<1.5	15	0	DGFET	$ 44.95
P150VDA, P160VDA, P170VDA	150-160, 160-170, 170-180	<1.1	15	0	DGFET	$ 56.95
P150VDG, P160VDG, P170VDG	150-160, 160-170, 170-180	<0.5	24	+12	GaAsFET	$109.95
P450VD, P460VD	450-460, 460-470	<1.8	15	−20	Bipolar	$ 49.95
P450VDA, P460VDA	450-460, 460-470	<1.2	16	−20	Bipolar	$ 74.95
P450VDG, P460VDG	450-460, 460-470	<0.5	16	+12	GaAsFET	$109.95
P800VDG, P830VDG, P860VDG	800-830, 830-860, 860-890	<0.6	19	+12	GaAsFET	$119.95
Inline (rf switched)						
SP30VD, SP35VD, SP40VD, SP45VD	30-35, 35-40, 40-45, 45-50	<1.4	15	0	DGFET	$ 74.95
SP30VDG, SP35VDG, SP40VDG, SP45VDG	30-35, 35-40, 40-45, 45-50	<0.55	26	+12	GaAsFET	$139.95
SP150VD, SP160VD, SP170VD	150-160, 160-170, 170-180	<1.6	15	0	DGFET	$ 74.95
SP150VDA, SP160VDA, SP170VDA	150-160, 160-170, 170-180	<1.2	15	0	DGFET	$ 86.95
SP150VDG, SP160VDG, SP170VDG	150-160, 160-170, 170-180	<0.55	24	+12	GaAsFET	$139.95
SP450VD, SP460VD	450-460, 460-470	<1.9	15	−20	Bipolar	$ 79.95
SP450VDA, SP460VDA	450-460, 460-470	<1.3	16	−20	Bipolar	$104.95
SP450VDG, SP460VDG	450-460, 460-470	<0.55	16	+12	GaAsFET	$139.95

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Circle (98) on Fast Fact Card

Interference generators test for specification compliance



The UCS500M/2 and UCS500M/4 from **Amplifier Research** are compact interference generators that test for full compliance to six specifications for immunity: IEC-1000-4-2, 4-4, 4-5, 4-8, 4-9, and 4-11. Testing to six specifications in a small unit (19" × 5.25" × 21") is made possible by technology that integrates waveforms—burst, surge, voltage dips, power frequency and magnetic fields and electrostatic discharge—using a built-in coupling/decoupling network. The M/2 tests to 2,500V, the M/4 to 4,400V. Extra test margin in some applications is provided by the M/4. EMC, medical, general label and manufacturer-specific requirements are supported. Both units are available without ESD testing capability. All test routines can be conducted using front-panel keypads and menu-driven displays. The instruments can be operated remotely. Built-in IEEE 488/RS-232C interfaces and optional Windows-based software support PC-based remote control.

Circle (419) on Fast Fact Card

Call repeater allows immediate access to recordings

Dictaphone's Encore instant call repeater is designed to give call takers immediate fingertip access to critical recorded phone or radio communications. Installed directly on a communication center's Windows 95/Windows NT CAD workstations, Encore's control screen gives call takers access to emergency calls with a single mouse click or keystroke. The result is a faster reaction time for call takers, who can now dispatch and retrieve calls from the same workstation. Call takers can listen to calls recorded on Encore's shared memory module, without interrupting recording, simply by clicking the recall button on the control screen. Or they can mark a segment of a call to replay over and over. The system allows call takers to save recordings as .wav files using their workstations' multimedia capabilities. The recordings can then be emailed to a supervisor or saved for training.

Circle (420) on Fast Fact Card

Literature

Catalog introduces new ordering system for antennas

STI-CO Industries' new catalog simplifies the procedure for ordering its vehicular antennas. With this lean and colorful catalog, all of the extra components are included with the antenna and do not need to be ordered separately. The Complete Antenna System Package installation kit includes antenna, cables, broadcast coupler, connectors and duplexer, if necessary. The package is available for one price for a ready-to-install system. STI-CO will still satisfy requests for individual components, but the new all-in-one package requires only that the customers specify what kind of vehicles they drive. STI-CO will then engineer the orders for their specific applications. The completely integrated antenna system is designed to be installed with minimum effort and to work as a customized assemblage of compatible units. The catalog also features new antenna system diagrams, a fold-out specifications chart, technical notes, commonly-asked technical questions and a simplified order form that will help to guide the customer through the selection process.

Circle (451) on Fast Fact Card

PCIA releases RF compliance guide to help CMRS carriers

To help FCC license holders and commercial mobile radio service (CMRS) carriers comply with the Federal Communications Commission's new RF rules, the Personal Communications Industry Association (PCIA), in conjunction with a cross-section of industry representatives, has prepared a document titled *Priority Actions for Timely Compliance: Safety Measures for Building-based Antenna Sites.* This guide helps CMRS carriers, site owners and site managers understand the FCC's new RF guidelines. Dozens of industry representatives from across the wireless industry worked with PCIA to develop the document, which is a result of PCIA's RF summit held in Dallas in August 1997. The guide is posted in the public viewing section of the PCIA Web site at *www.pcia.com* and is available on request.

Circle (452) on Fast Fact Card

Catalog covers indoor, outdoor antennas, small mechanical profiles

Huber+Suhner's *PCS 1900 Antennas* catalog covers antennas for both indoor and outdoor environments. This catalog features antennas with the smallest mechanical profile available without compromising on performance. The product family features polarization diversity, electrical and mechanical downtilt, peak gain up to 18.5dBi, horizontal and vertical beamwidth, repeatable VSWR as well as radiation and pattern performance. Actual measured radiation patterns are shown for each antenna model. Standard and optional mounting brackets are included.

Circle (453) on Fast Fact Card

Brochure offers background info on wireless communications industry

Hewlett-Packard's new backgrounder is written for analysts who follow the wireless communications industry. The backgrounder, "Achieving Quality in the Wireless Industry," provides information and insight on HP's business strategy in wireless communications and challenges facing wireless service providers and equipment manufacturers in today's competitive market. The 16-page brochure contains stories and examples, with quotes from HP executives and easy-to-read diagrams. The brochure also offers a glossary of industry acronyms.

Circle (454) on Fast Fact Card

VOICE SECURITY ENCRYPTION

The Model NC802 is a miniature inversion scrambler designed to provide intermediate level security for two-way radio voice communication systems and is a perfect, cost effective solution to entry level voice scrambling as a defense against unauthorized or casual listeners. The NC802 provides eight user selectable carrier codes commonly used by other manufacturers and interfaces easily to most radios with near transparency to the user.



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Circle (90) on Fast Fact Card

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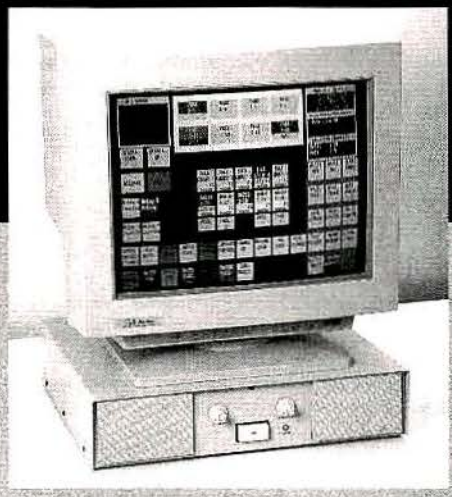
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- ◆Simultaneous conferences
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Web site: www.avtecinc.com

Circle (92) on Fast Fact Card

People


Villa


Perelman


Jakubowski


Black

Allen Telecom, Cleveland, creates a new Worldwide Site Products Division. The division combines FOREM S.r.l., Milan, Italy, with the former Site Products divisions in Cleveland and Sparks, NV. **Piero Villa,** formerly president of FOREM S.r.l., is president of the new division.

Robert Perelman leaves Times Microwave Systems, Wallingford, CT, as vice president of marketing to join Eupen Cable USA, Orange, CT, as vice president of sales and marketing.

Ronald J. Jakubowski departs Allen Telecom's Systems Division, Solon, OH, as principal engineer to join TX RX Systems, Angola, NY, as systems engineering manager.

Stacey Black, former vice president of marketing for Sony Electronics, Park Ridge, NJ, becomes vice president of marketing-strategic business development of the Wireless Terminals Division at Siemens Business Communications Systems, Richardson, TX.

Dwayne Aspaas, account executive covering sales in the Northwestern United States for Coded Communications, Carlsbad, CA, advances to general manager, international sales.

Unique Technologies International, Irving, TX, has changed its name to ComSpace, and with the acceptance of an $8.5 million equity investment, it has created a new board of directors. Continuing from the previous board are **Steven E. Fulford,** ComSpace president; **David L. George,** ComSpace executive vice president; and **Gordon Simmonds,** president of Lenbrook Industries (and the previous chairman of Unique). New board chairman **Jon Bayless** is managing partner of Sevin Rosen, one of the new equity investors. **Bob Paluck,** director of Centerpoint Ventures, another new equity investor, is another new board member. Other new board members include **Alfonso Cordero,** chairman of Powerwave Technologies; and **Thomas Aschenbrenner,** a consultant.

Changes at Narda Microwave-East, Hauppage, NY: **John C. Stine** departs Lockheed Martin Electronic Systems, Yonkers, NY, as manager of quality assurance, to join Narda as director of quality assurance. **Michael J. Sanator** leaves Lockheed Martin Tactical Defense Systems, Great Neck, NY, as director of manufacturing and material operations to join Narda as director of operations. **Joseph Langille**, vice president of finance at Narda Microwave-West, CA, advances to vice president of finance at Narda Microwave-East. **Robert A. Koelzer**, product line manager for Passive Products, becomes director of engineering. **Vinod Chitkara,** vice president of sales advances to senior vice president of sales and marketing.

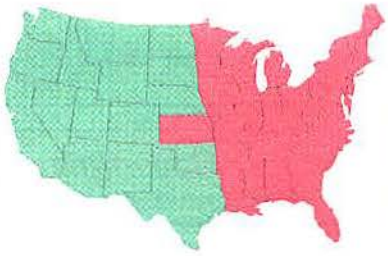
Michael F. Robinson departs as area manager of engineering and operations at Sprint PCS, Atlanta, to join Southern Linc as director of enginering and operations.

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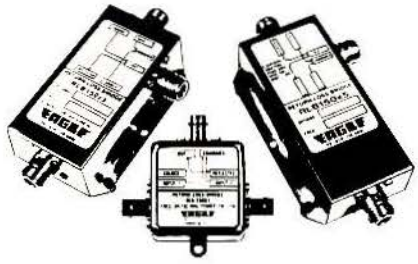
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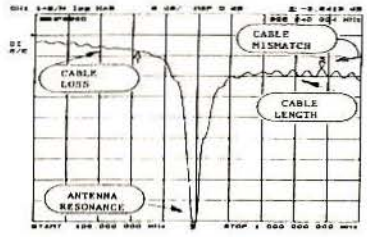
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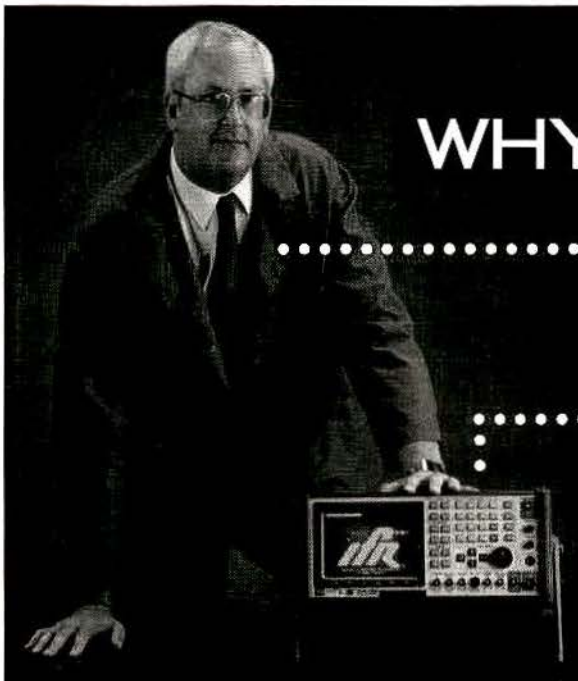
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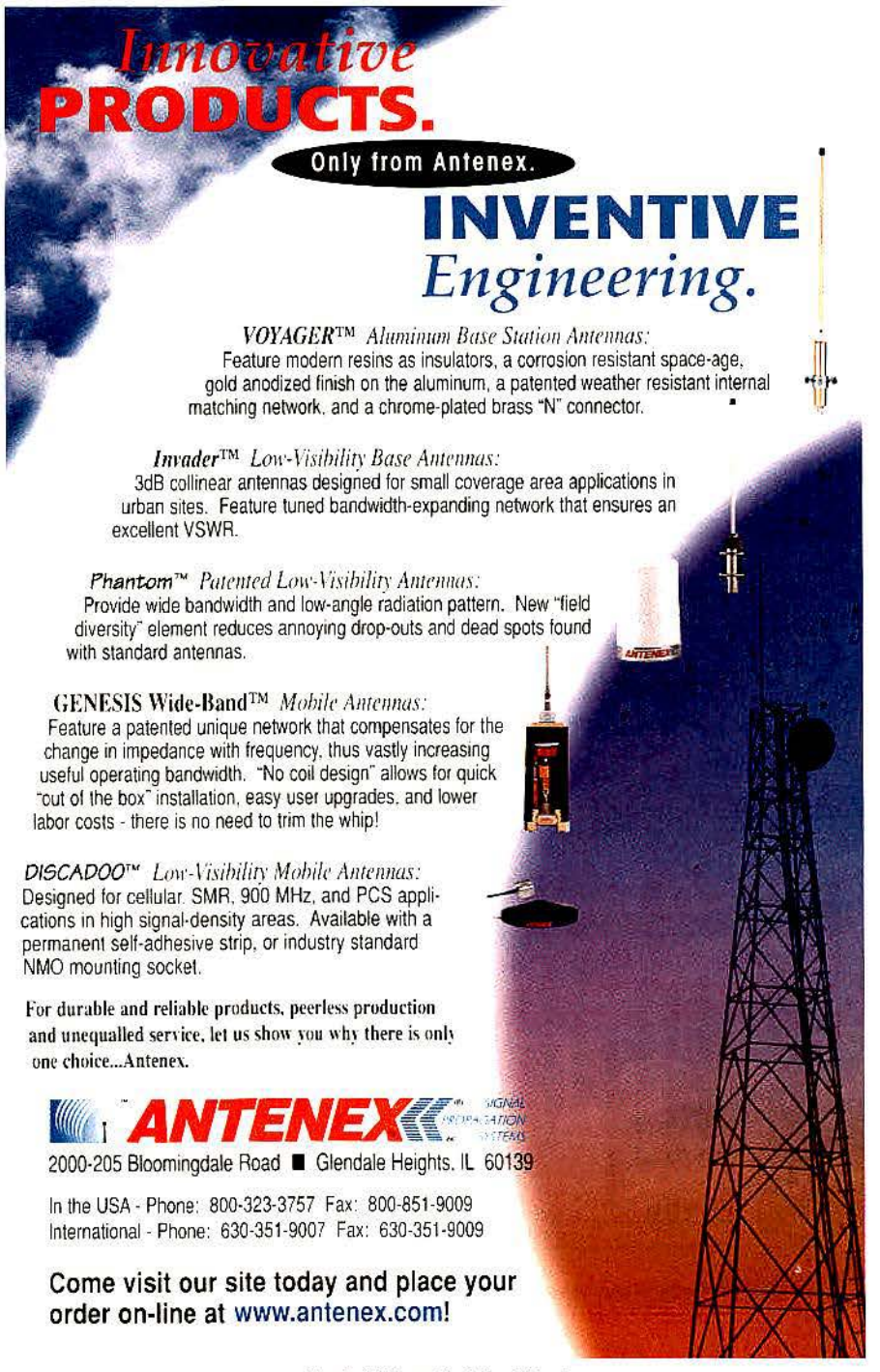
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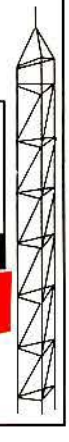
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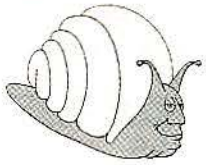
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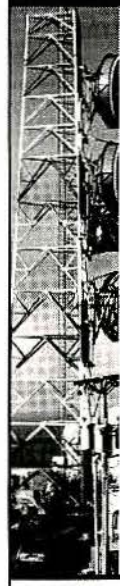
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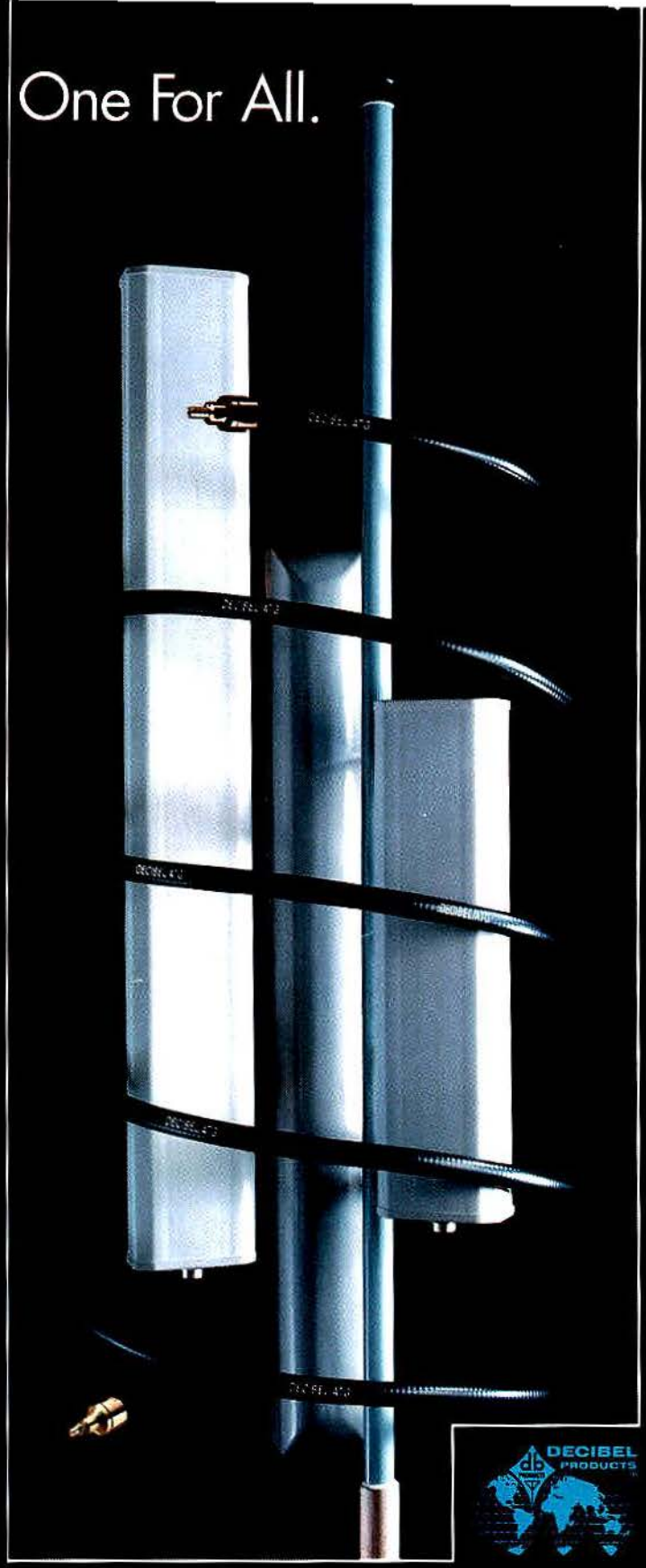
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TPL Communications Inc.	70	73	213-256-3000
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Trilogy Communications Inc.	17	8	601-932-4461
Tripp Lite	38	39	312-755-8741
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Twitco Distributing	96	71	800-899-8948
TX RX Systems Inc.	3	5	716-549-4700
Uniden Corp.	57	50	817-858-3300
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Vega, A Mark IV Company	12	16	818-442-0782
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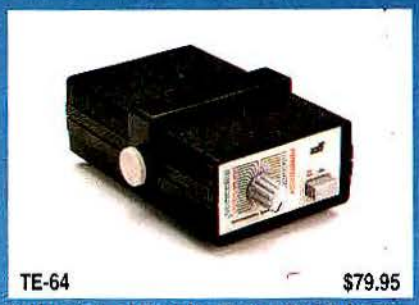
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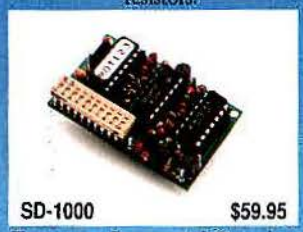
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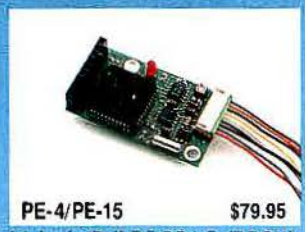
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